THE FUNDAMENTAL PRINCIPLES OF AYURVEDA Part III

By C.Dwarakanath

The Fundamental Principles of Āyurveda

PART III

Āyushkāmiya and Dravyādi Vignāna
(including Rasabhediya) of Ashtānga Hridaya

By

C. DWARAKANATH

PRINCIPAL

Government Ayurvedic & Unani College, Mysore.

FOREWORD

By

DR. K. S. MHASKAR,

M.A., M.D., D.P.H. & D.T.M. & H.

Chairman, Board of Research in Āyurveda,
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Price: *Rs.* 7-8-0

Dedicated to

My Preceptors

Vaidyaratna Capt. G. Srinivasamurti

B.A., B.L ,M.B.C.M.

AND

Vidwan U. P. Sankunni Menon

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FOREWORD

The present book is a serious attempt at explaining the Fundamental Principles of Ayurveda to students of Modern Medical Science and as such worthy of consideration and respect for the efforts by the author.

Such a book has been badly wanted by such of those who cannot understand Sanskrit or Hindi and find it difficult to follow the Text from the original Sanskrit Literature. The subject has been well divided in a continuous series of Sections which follow each other as a link in its part of a difficult subject.

It is no easy job to explain the deep meanings of some of the Ayurvedic terms which when translated into English practically destroy the sense of what originally had been meant. The temptation to do so is often very great and difficult to avoid and requires great tact and patience for the author to give the exact rendering of the sense in which the term had been used.

The author has attempted in some places to find equivalent renderings in Modern Medical Science of the Biological, Chemical and Pathological processes so cryptically explained in Ayurveda, and which the Sanskrit Commentators had found difficult to expound.

Vata, Pitta and Kapha whether they be called Dhatus or Dosas, are practically the Soul or the pivot, round which the whole sense of Ayurveda turns.

The Author has taken pains to impress on the readers that Ayurveda is more a book for the exposition of health rather than of diseases.

Special attention has been given to Dravyas and the properties which ought to make it easy for one to understand what they are, and the great part they play both in the Physiology and Pathology of the body

I consider the book worthy of a place on the Library Shelf for such of those students of Modern Medical Science who desire to delve into Ancient Literature and pick out from it such gems as would form the basis for a future investigation. The literature often contains plenty of confirmative evidence and is easily available to those who care to read it with sympathy and desire for knowledge.

I congratulate the Author on satisfying this desire and pointing out the place where such information might lie.

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15th May 1954

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AUTHOR'S NOTE

The present work like the preceeding ones has grown out of my lecture notes on the Fundamental Principles of Ayurveda—selected portions of Sutrasthana of Ashtanga Hridaya viz., Chapters I, IX and X. It represents the extension of the various principles discussed in the first two parts of this series to the study of the doctrines basic to Ayurveda, such as its pharmacological concepts Rasa, Guna, Virya, Vipaka and Prabhava.

I am issuing this work as the III Part in the series of my publications on the Fundamental Principles of Ayurveda and as its title indicates, the first section deals with topics discussed in the chapter on Ayushkamiya of Ashtanga Hridaya, and the second section deals with the Dravyadi Vignana, including Rasa Bhediya. Dosha-Dhatu-Mala Vignana will be published as the IVth part in this series, during the course of this year.

In getting up my lecture notes on the various topics dealt with in this work, I have endeavoured to approach old problems of Ayurveda from a new angle. I have in addition, made an approach to new contributions of modern science from an old angle. These two approaches have made the ancient doctrines of Ayurveda intelligible to students of modern science in general and students of medicine in particular. The concepts of Rasa, Guna, Virya, Vipaka and Prabhava, which have been the bone of contention among scholars and Pandits for over thousand years, have been scientifically elucidated and an intelligible and demonstrable orientation has been given to them.

The publication of this work was made possible largely due to the keen interest evinced in it and the financial aid rendered by that distinguished physician of Madras, Dr. M. R. Guruswamy Mudaliyar, B.A., M.D., Honorary Director of Indigenous Medicine. I am grateful to Dr. K. S. Mhaskar, M.A., M.D., D.P.H., Chairman, Board of Ayurvedic Research in Bombay, for having kindly contributed a valuable foreword to this work. I would also like to place on record my thankfulness to my colleagues Dr. Mahadeva Sastry and Dr. M. Lakshminarayana, who have given me the benefit of their studies of the various topics discussed in this work, and the services renderd by Sri S. Narayana Sastry, who got up the manuscript with his flawless and efficient typing.

Government Ayurvedic &
Unani College, Mysore.
24th July 1954.

C. Dwarakanath
Principal.

The Fundamental Principles of Āyurveda

PART III

Section I

'AYUSHKĀMIYA'

INTRODUCTORY

The author of the reputed *Ayurvedic* classic *Ashtānga Hridaya* was *āchārya Vāgbhata*. He was one of the authoritative *trios* of *Āyurveda*—the other two being *Charaka* and *Susruta*. Their works viz., *Charaka Samhita*, *Susruta Samhita* and *Ashtānga Hridaya* respectively, are known together as the *brihat trayi* or the '*great trio.*' Between them, these three works from the basis of *Ayurveda.*

Authorities entiled to an opinion believe that *Āchārya Vāgbhata* lived in the early seventh century of the christian era or about 625 A.D. He is stated to have originally belonged to Sind and latter migrated and settled down at Kerala (Malabar) where he is said to have compiled his *Ashtānga Hridaya* Authorities are divided in their opinion as to the authorship of *Ashtānga Samgraha*—a sister and an anterior work. There is, however, a large section among them who consider that there were two *Vāgbhatās* viz., the senior and the junior. The former work is ascribed to the junior *Vāgbhata* and the latter to the senior,

Opinion is also divided as to the religion to which *āchārya Vāgbhāta* the author of *Ashtānga Hridaya*- belonged. While some hold that *āchārya Vāgbhata* was a Buddhist, there are others who stoutly maintain that he was an orthodox Hindu.

The great medical classic—*Ashtānga Hridaya*—is not only a compilation of all authoritative works on Medicine of *Vāgbhatā's* time but also those anterior to it which, it is seen, were in a chaotic state. In a sense, *Ashtānga Hridaya* represents the latest available authoritative work on HinduMedicine and allied subjects. *Charaka Samhita* is essentially a treatise on Medicine and Ṭherapeutics, whereas, *Susruta Samhita* is in the main devoted to surgery including otto-rhino-laryngeology and opthalmology. On the other hand, *Ashtānga Hridāya*, as its very name suggests, deals with the eight essential and vital branches of treatment. This work is not only a medical classic of considerable value but it is also a *Samskrita kāvya par excellence.* In a word, it is the cream of the ancient medical literature of India.

Sūtra Sthāna

Sūtra means aphorism and *sthāna*, the place or section. *Sūtrasthāna*, therefore, means the 'section of aphorisms.' The *sūtrasthāna* of *Ashtānga Hridaya* with which *āchārya Vāphata* begins is considered to be the most valuable section of the entire work. It is in fact, in this section that *āchārya Vāgbhata* has dealt with some of the fundamental aspects of *Ayurveda.* In a way, this section is also a synopsis of the entire work.

It holds the key to the treasure-chest of knowledge contained in the remaining sections of the main work, and therefore, considerable importance is attached to this section. It has ben stated and justifiably too, that *āchārya Vāgbhata* is an authority on *Sūtrasthāna*, *Susrutha* on *Sārira*, *Mādhavakara* on *Nidāna* and *Charaka* on Medicine and Therapeutics.

निदाने माधवः श्रेष्ठः सूत्रस्थाने तु वाग्भटः ।
शारीरे सुश्रुतः प्रोक्तो चरकस्तु चिकित्सिते ॥

Obeisance to the Diety

In conformity with the traditional practice in India of invoking and paying obeisance to the diety before the undertaking of or embarking on any new enterprise, especially literary or scientific in nature, *āchārya Vāgbhata* has also paid his obeisance to the diety, with this difference that the diety invoked by him was not a personal God, such as *Vishnu*, *Shiva*, *Skanda* or *Vighneswara* and the rest, but a rare and unique *vaidya* or doctor possessing certain special qualifications. It also envisages a profound scientific truth, which in the present, is represented by the latest development in Medicine, known as the *psycho-somatic concept* of diseases. According to this concept, the origin of a large number of diseases can be traced to a prior-proximate or remote mental origin.

Āchārya Vāgbhatā's invocation of the diety reads as follows :

रागादिरोगान् सततानुषक्ता-
नशेषकायप्रसृतानशेषान् ।
औन्मुक्यमोहारतिदाञ्जघान-
योऽपूर्व वैद्याय नमोऽस्तु तस्मै ॥

"I pay my obeisance to that rare (unique) *vaidya* who has totally annihilated such diseases as *rāga* etc., which are deeply rooted and are present everywhere and at all times in the body, and which give rise to sensuousness, delusion and restlessness etc."

The term '*ādi*' or etc., comprises of the following, in addition to sensuous desires :

i. *Dwesha* or hatred and dislike ;
ii. *Mada* or haughtiness, arrogance and egoism ;
iii. *Mātsarya* or intolerance, spite, malice etc. ;
iv. *Kāma* or libidinal impulses and lust ;
v. *Krodha* or anger, rage etc. ;
vi. *Bhaya* or fear-complex ;
vii. *Lobha* or greed and coveteousness ;
viii. *Moha* or delusion ;
ix. *Vishāda* or depression states, dejection of spirits, despondency and maniacal tendencies ;
x. *Soka* or grief ;
xi. *Asūya* or jealousy ;
xii. *Avamāna* or humiliation ;
xiii. *Irsha* or envy, impatience.

It appers to have been fully recognised by the ancient Hindu Medicine that desire, especially the sensuous, is at the bottom of and leads to mental or emotional conflicts, tensions, frustrations, inhibitions and suppressions, with their inevitable repercussions on the '*soma*' or body, leading to the manifestation of varieties of diseases and disease syndromes. This doctrine has also served as the bed-rock of some of the fundamental tenets of *Ayurveda*, as can be seen from

āchārya Vāgbhatā's invocation of the diety extracted above. Even earlier than *Vāgbhata*, the *Sāmkhya* school of philosophy and the *Gita* have stated this fact very succinctly. According to the former, *ādhyātmika duhkkha* which is one of the three kinds of miseries in the human being is of two kinds viz., *sāririka* or *somatic* and *mānasika* or *psychic*. The former i.e., *sāririka* or *somatic* arises on account of intrinsic disturbances in the '*soma*'—both functional and structural—whereas, the latter i.e., the *psychic* arises as a result of the "*dissociation of the mind from what is liked and its association with what is disliked*".

मानसं प्रियवियोगाप्रियसंयोगादि ।

(Kārika)

Lord Sri Krishna has expressed this truth more vividly as follows :

ध्यायतो विषयान्पुंसः सङ्गस्तेषूपजायते ।
सङ्गात्संजायते कामः कामात्क्रोधोऽभिजायते ॥
क्रोधाद्भवति संमोहः संमोहात्स्मृतिविभ्रमः ।
स्मृतिभ्रंशाद्बुद्धिनाशो बुद्धिनाशात्प्रणश्यति ॥

(Gita, Ch. II, 62–63)

"Man, musing on objects of the senses concieveth attachment to these ; from attachment ariseth desire ; from desire anger cometh forth ; from anger proceedeth delusion ; from delusion confused memory ; from confused memory the destruction of reason ; from destruction of reason he perisheth."

The term 'Āyurveda'—its meaning, scope and outlook

The study of *Ayurveda* presupposes a proper and prior appreciation of the definition of this term, its

content, scope and implications. The need for such an appreciation becomes emphasised on account of the prevalent ignorance of this subject in the present.

Āyurveda—a biological science : The term *Āyurveda* comprises of two words viz., *āyuh* and *veda*. *Ayuh* means life and '*veda*', science or knowledge of. The term *life* includes *life process* and *living states*. The nearest modern equivalent of this term is *biology* which is composed of two Greek words viz., *bios* meaning life and *logos* science or knowledge of. *Āchārya Susruta* defiines *Āyurveda* as :

आयुरस्मिन् विद्यते, अनेन वाऽऽयुर्विन्दन्ति इत्यायुर्वेदः ।

(Susruta, Ch. I; 15)

"The term *Ayurveda* may be interpreted as a science in which the knowledge of life exists or which helps a man to enjoy a longer duration of life".

Unlike modern biology, which *at present* does not include the knowledge or the science of the mind or psychology in its scheme of *life process or living states* but seeks to define the *vital and mental processes* from a purely mechanistic physical point of view, the term *āyuh* or life, has been described as the 'totality of events', representing the correlation of and interaction between the body, senses, mind and *ātma*. *Charaka* defines the term '*āyus*' as "the union of body, senses, mind and the spirit',.

शरीरेन्द्रियसत्त्वात्मसंयोगो धारि जीवितम् ।

(Charaka, Sutra, Ch. I; 42)

Ayurveda i. e., the science (or knowledge) of life, like its modern counterpart biology, comprises of *prakrithi vignāna* or the Science of Matter i. e., physics, and *rasāyana sāstra* or chemistry. This will become evident from the following extracted from *Arunadattā's Sarvāngasundara* commentary on *Ashtānga Hridaya* :

आयुर्वेदयति ज्ञापयति प्रकृतिज्ञान[1] रसायन[2]
धूतारिष्टाद्युपदेशादित्यायुर्वेदः[3][4] ।

The Scope of Aurveda : The scope of *Ayurveda* is both preventive and curative. This will become evident from *āchārya Susrutā's* description of it extracted below :

वत्स सुश्रुत ! इह खल्वायुर्वेदप्रयोजनं—व्याध्युप-
सृष्टानां व्याधिपरिमोक्षः स्वस्थस्य रक्षणम् च ।

(Susruta ; Sutra I; 14)

'*Susruta*, my son! the object or utility of the science which forms the subject matter of our present discussion, may be grouped under two distinct heads, viz., (i) the cure of persons afflicted with disease, and (ii) the preservation (or the maintenance) of the health in the healthy.'

According to *Charaka Samhita* " the utility of the science of *Ayurveda* consists in the maintenance of the health in the healthy and the relief of abnormal states of health in the ailing "

1. According to the Samkhya 'prakriti' is 'matter' and 'nature'
2. The term 'rasayana' means chemistry.
3. Dhuthagnana means "the knowledge of omens
4. Arishta means the knowledge of impending death.

प्रयोजनं चास्य स्वस्थस्य स्वास्थयरक्षणमातुरस्य-
विकारप्रशमनम् च ।

(Charaka; Sutra 30: 26)

The Raison D Étre of Health and Longevity

The question now arises as to why the Science and Art of *Āyurveda* should be assiduously studied, and its teachings cultivated and practiced. In the words of *achārya Vāgbhata:*

आयुः कामयमानेन धर्मार्थसुखसाधनम् ।
आयुर्वेदोपदेशेषु विधेयः परमादरः ॥

"Longevity is to be desired (and earnestly worked for), as on it depends the performance of one's duty or *dharma* (unto oneself, ones family, society, nation and in short, the humanity); the reaping of the benefits of duty well-performed and the enjoyment of the pleasures and happiness of life. Hence, the teachings of *Āyurveda* have to be listened to respectfully (and attentively) and the knowledge imparted by it assiduously cultivated and diligently practised."

Charaka has omitted *dharma* in his "त्रैषणीय" or the "three pursuits of man" and in its place, substituted "प्राणैषण" or the "urge of life" (*elan vital*). In the place of *sukha*, he has substituted the pursuit of the "other world" whereas, *āchārya Vāgbhata* has ignored the last of the three pursuits of man, posited by *Charakāchārya*, and has included *dharma* in the place of latter's "pursuit of life." Whatever may be the difference between these two authorities in this regard, we may consider here the implications of the term *dharma*, *artha* (corresponding

to "धनैषण" of *Charaka*) and *sukha*. Prior to the study of these, we may consider "प्राणैषण" or the pursuit of life, for, the life or the state of living is the condition precedent for every other pursuit. This will also, in a very large measure, amplify the main scope of *Ayurveda*.

Charakāchārya gives top-priority to *prānaishana* and states that "the giving up of life will mean the giving up of everything":

आसां तु खल्वेषणानां प्राणैषणां तावत् पूर्वतरमापद्येत । कस्मात् ? प्राणपरित्यागे हि सर्व त्यागः ।

(Charaka, Sutra 11 ; 4 (1))

The preservation of life, according to *Charakāchārya* has to be done in two ways viz.,

(i) by the healthy, observing the rules of health, and (ii) by the ailing, by the diligent alleviation of abnormalities which characterise ill-health.

तस्यानुपालनं—स्वस्थस्य स्वस्थवृत्तानुवृत्तिः,
आतुरस्य विकारप्रशमनेऽप्रमादः ।

(Ibid 4 (ii))

Dharma : The term *dharma* is derived from the Samskrit root धृ to hold, support etc. This word has many meanings of which the following are important.

Law	Mode	Nature
Duty	To hold together	Characteristic-property
Equity	Integrate	Manner
An essential-quality	Righteousness	Virtuous and moral conduct.
Peculiar attribute	Justice	

This term can be used appropriately in different contexts. For example, the *dharma* of the heart is to pump blood and keep it in circulation all over the body; the *dharma* of the central nervous system is to integrate, correlate, co-ordinate, control, regulate and direct the functions of the various organs and systems of the body and make it work as a single organism or a composite unit. The *dharma* of the food is to supply the energy requirements and meet the needs of the wear and tear of the constituent elements of the living organism, and thus contribute to its well being. The *dharma* of the whole man is to exist in harmony with nature and his environment—physical, moral, psychological, social, political, economical and so forth. In the present context, the term *dharma* signifies rightful conduct and the performance or observance of duties—individual, social, moral, ethical etc,—enjoined on man, unto himself and to the world at large.

Artha: The word *artha* means the object of the senses; the fruits of work or endeavour; means; wealth, etc. This is the second of *Charakāchāryā's* "three pursuits" or "*traishaniya*". It has been treated as next only in importance to the act of living. Says the *ācharya*; "Next, the pursuit of wealth should be taken up. For, after life, wealth is the end to be sought. Surely, there is no misery which can be more miserable than that of a man blessed with a long life but lacks the means that makes life worth living. Effort should, therefore, be made to acquire the required means or the wherewithal to live. The means of acquisition of these necessaries are,

agriculture, the rearing of cattle, trade (and commerce), the service of the King (State), etc. In addition to the above, a person may take to such other avocations as are apt to one's knowledge and not disapproved of by the righteous and provide both livelihood and opulence. Conducting himself in this manner, a man lives for long and with dignity.".

अथ द्वितीयां धनैषणामध्यायं, प्राणेभ्योऽनन्तरं धनमेव पर्येष्टव्यं भवति; न ह्यतः पापात् पापियोऽस्ति यदनुपकरणस्य दीर्घमायुः, तस्मादुपकरणानि पर्येष्टुं यतेत। तत्रोपकरणोपायाननुव्याख्यास्यामः; तद्यथा—कृषिपाशुपाल्य वाणिज्य राजोपसेवादीनि, यानि चान्यानपि सतामभिगर्हितानि कर्माणि वृत्तिपुष्टिकरणि विद्यात्तान्यारभेत कर्तुं; तथाकुर्वन् दीर्घजीवितं जीवत्यनवमतः पुरुषो भवति।

(Charaka, Sutra II, 5)

Sukha : The term *sukha* means joy; happiness; delight; pleasure; comfort etc. It also indicates an attitude of a fully satisfied mind which expresses itself in a variety of ways, especially, the subjective feeling of the sensations referred to above. It may also be interpreted as a state of freedom from pain and misery (both mental and physical). Says *Charaka.* "*Ārogya* is characterised by a sense of ease and it indicates a disease-free state...."

सुखसंज्ञकमारोग्यम्.....।

(Charaka).

अनुकूलतया वेदनीयं सुखम्।

(Tarka Samgraha)

Stated in brief, the meaning, scope and outlook of *Ayurveda* may be summed up in the words of *Charakāchārya* as follows :

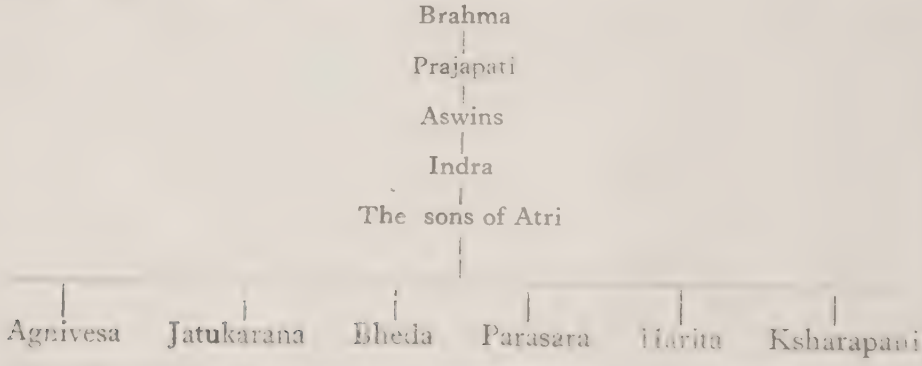
"That is named the " Science of Life' wherein are laid down, what is conducive to or otherwise for the preservation of life, the happy and unhappy life, and the wholesome and unwholesome in relation to life, as also the measure of life."

हिता हितं सुखं दुःखमायुस्तस्य हिता हितम्।
मानं च तच्च यत्रोक्तमायुर्वेदः स उच्यते ॥

(Charaka)

The Legendary Origin of Āyurveda

According to the texts and traditions, the origin of *Aurveda* has been traced to the Creator of the Universe-Brahma. Brahma, it is stated, remembered (recollected or called to memory) *Ayurveda* and imparted it to *Prajāpati*. The latter, in his turn, taught the science to the celestial twins–*Aswini* brothers. They initiated *Indra*, who in his turn, taught the subject to the sons of the holy *Atri*.[1] They, in their turn, imparted the knowledge of the science to *Agnivesa* and the rest.[2] Each one of them then, wrote separate and special treatises of their own.



1. Atri's sons are stated to be Atreya, Dhanvantari, Nimi, Kasyapa and the rest.

2. The term Agnivesadi comprehends: Agnivesa, Bheda Jatukarana, Parasara, Harita and Ksharapani.

ब्रह्मा स्मृत्वायुषोवेदं प्रजापतिमजिग्रहत् ।
सोऽश्विनौ तौ सहस्राक्षं सोऽत्रिपुत्रादिकान्मुनीन् ॥
तेऽग्निवेशादिकांस्तेतु पृथक् तन्त्राणी तेनिरे

With the passage of time, all the great classical works on *Ayurveda* taught by the disciples of the sons of *Atri* became scattered and some of them even lost. *Āchārya Vāgbhata* is stated to have collected the essence and the more valuable features of the extant works of his time to compile his earlier work *Ashtānga Samgraha.* The essential features of this work has again been presented by him in his now famous work, the *Ashtānga Hridaya* or 'The heart of the Eight Limbed' medical system, which is neither elaborate nor brief.

तस्योऽतिविप्रकीर्णेभ्यः प्रायः सारतरोच्चयः ।
क्रियतेऽष्टाङ्गहृदयं नातिसंक्षेप विस्तरम् ॥

Ayurveda an Eternal and Progressive Science

Ayurveda is stated to be eternal in its scope and progressive in its outlook. This claim has, however, been wrongly interpreted by the modern critics of *Ayurveda*, and taken to mean that the last word has been said in the medical science and that such a claim would amount to a dogmatisation of old, obsolete and exploded doctrines. That such an interpretation is erroneous and is based on a wrong reading of the claim, will be seen from a close examination of the reasoning adopted by *Charaka Samhita* to posit such a claim. According to this authoritative work, "*Ayurveda* or the Science of Life is declared to be eternal as it had, not only no beginning, but also as it deals with tendencies that proceed from *nature*, and the nature of *matter* is eternal."

सोऽयमायुर्वेदः शाश्वतो निर्दिश्यते, अनादित्वात्, स्वभावसंसिद्धलक्षणत्वात्, भावस्वभावनित्यत्वाच्च ।

(Charaka, Sutra 30; 27)

This work further observes: "For, at no time was there a break either in the continuity of life or the continuity of intelligence. The experience of life is perineal. Pleasure and pain together with their respective causative factors are beginning less on account of their mutually determining nature. This forms the group of subjects with which *Ayurveda* deals."

नहि नासीत् कदाचिदायुषः सन्तानो बुद्धिसन्तानो वा, शाश्वतश्चायुषो वेदिता, अनादि च सुखदुःखं सद्रव्येहेतुलक्षणमपरापरयोगात् । एष चार्थसंग्रहो विभाव्यते आयुर्वेदलक्षणमिति ।

(Ibid)

"For," says this *Samhita*, "at no time can it be said that *Ayurveda* sprang into existence, having been non-existent before, unless the dissemination of knowledge by means of receiving and imparting instruction be considered as the creation of such knowledge. It is indeed, in view of such dissemination by the channel of instruction, that some authorities have spoken of the rise of the 'Science of Life' at this or that time."

न ह्यायुर्वेदस्याभूत्वोत्पत्तिरुपलभ्यते, अन्यत्रावबोधोपदेशाभ्याम्; एतद्द्वयमदिकृत्योत्पत्तिमुपदिशन्त्येके ।

(Ibid24 (4))

"As a matter of fact," observes this work "the function of this science is implicit in nature and owes nothing to artifice"

स्वाभाविकं चास्य लक्षणमकृतकं, यदुक्तमिहाद्येऽध्याये च :..... ।

(Ibid)

Its Contents—Eight Limbs

The eight limbs of treatment or the main branches of *Ayurveda* alluded to above are :

1. Kāya chikitsa or Inner medicine ;
2. Bāla chikitsa or Paediatrics ;
3. Graha chikitsa or Psychiatry ;
4. Urdhvānga chikitsa or Otto-rhino - laryngeology and opthalmalogy;
5. Salya chikitsa or Surgery ;
6. Damshtra chikitsa or Toxicology ;
7. Jarā chikitsa or Geriatrics and rejuvenation ;
8. Vājeekarana or the science of aphrodisiacs.

कायबालग्रहोर्ध्वाङ्गशल्यंदंष्ट्रा जरावृषान् ।
अष्टावङ्गानि तस्याहुश्चिकित्सा येषु संश्रिताः ॥

Strictly speaking *Aurveda* deals with ten aspects of Medical science, as shown below :

1. Anatomy
2. Physiology ;
3. Aeteology ;
4. Pathology ;
5. Therapeutics ;
6. Objectives ;
7. Climatology ;
8. Physicians;
9. Phamacology ;
10. Procedures,

तन्त्रार्थः पुनः स्वलक्षणैरुपदिष्टः । स चार्थः प्रकरणैर्विभाज्यमानो भूय एव शरीरवृत्तिहेतुव्याधिकर्मकार्यकालकर्तृकरणविधिविनिश्चयाद्दशप्रकरणः, तानि च प्रकरणानि केवलेनोपदेक्ष्यन्ते तन्त्रेण ।

(Charaka ; Sutra ; 30 ; 32)

In addition, *Charaka Samhita* deals with the Medical Science in eight sections viz.,

1. General principles ;
2. Pathology ;
3. Specific determination ;
4. Human embodiment ;
5. Sensorial prognosis ;
6. Therapeutics ;
7. Pharmaceutics, and
8. Measures for attaining success in treatment:

तन्त्रस्याष्टौ स्थानानि ; तद्यथा—श्लोकनिदानविमानशारीरेन्द्रियचिकित्सितकल्प सिद्धिस्थानानि ।

(Ibid 33)

The Tridoshās or Function-Triad

The *Āyurvedic* concepts of physiology, pathology, diagnosis, prognosis, medicine and therapeutics, are all based on the doctrine of *tridoshās* viz., *vāyu*, *pitta* and *kapha*. They are designated as *doshās* because of their capacity to vitiate and themselves become vitiated by other factors—दूषयन्तीति दोषः ।

They are also known as *dhātūs*, as they support the body in its normal states. The term *dhātū* means 'a constituent' or 'an esential element' or 'an ingredient'; 'a primary substance;' 'a humour;' 'the supporter' etc– धारणात् धातवः ।

In other words, *vāyu*, ,*pitta* and *kapha* in their normal states are the main supporters of the body. They are then known as *dhātūs*. Since they are themselves capable of being vitiated and as they also vitiate other factors in their turn, the *tridhāitūs* are also known as *doshās*.

The *tridhātūs* or *tridoshās*, which form the pivot round which every aspect of *Āyurvedā* rotates, have been rendered into English as wind, bile and phlegm. They have often been equated to the humoral concept of the ancient Greeks, such as Galen, Hippocrates and the rest– an obsolete doctrine-which holds that all diseases arise from the change of humors.[1] That such an equation is a misfit has been shown by the late lamented and well-known scientist of our country Sir P. C. Ray, who

1. The term 'humor' pertains to the natural fluids of the body (Gould's Medical Dictionary)

observes: "Too much has been made of the resemblance between the Greek and the Hindu theory and practice of Medicine. The analogy is more superficial than real and does not seem to bear a close examination. The Hindu system is based upon three humors, wind, bile and phlegm,[1] whilst that of the Greeks is founded upon four humors viz., the blood, bile, the water and the phlegm, a cardinal point of difference." Quoting the high authority of Dr. Hoernale who disposed off the view that the Hindus borrowed their notions of the humoral doctrine from Greeks as "an elaborate joke," Sir P. C. Ray observes that "such views are advanced by critics who represent a school which cannot and will not see anything in India which can claim originality or authority."

As we shall see in the 11th and 12th chapters of *Ashtānga Hridaya* viz., *Doshādi Vijnāna* and *Doshabhediya*, the *tridoshās* represent a generalisation of the functions of the living body grouped under three broad-based headings viz.,

i. Many of the physical and mental phenomena ascribed by the western physiologists primarily to the activities of the nervous system in all its different aspects—the central, the vegetative, and the perepheral including the autonomous—under the concept, *vāta*.

ii. Many of the physical phenomena attributed to *pitta* are, among those which modern physiologists include under the activities of thermogenetic and

1. We do not of course agree with the translation into English by Sir. P. C. Ray, the terms *vata*, *pitta* and *kapha* into wind, bile and phlegm. Such translations in the past by our enthusiasts have succeeded to the extant of reducing the sublime to the level of the ridiculous (the author).

nutritional systems (including the thermogenetic, the activities of glandular structures, especially enzymes and harmones, whose functions are of vital importance in digestion, assimilation, tissue-building and metabolism generally).

iii. Many of the functions of *kapha* are among those which the western physiologists include under the activities of the skeletal and anabolic–systems.

In the words of *āchārya Vāgbhata;* "Briefly stated *vāta, pitta* and *kapha* are the three *doshās.*"

वायुः पित्तं कफश्चेति त्रयोदोषाः समासतः ।

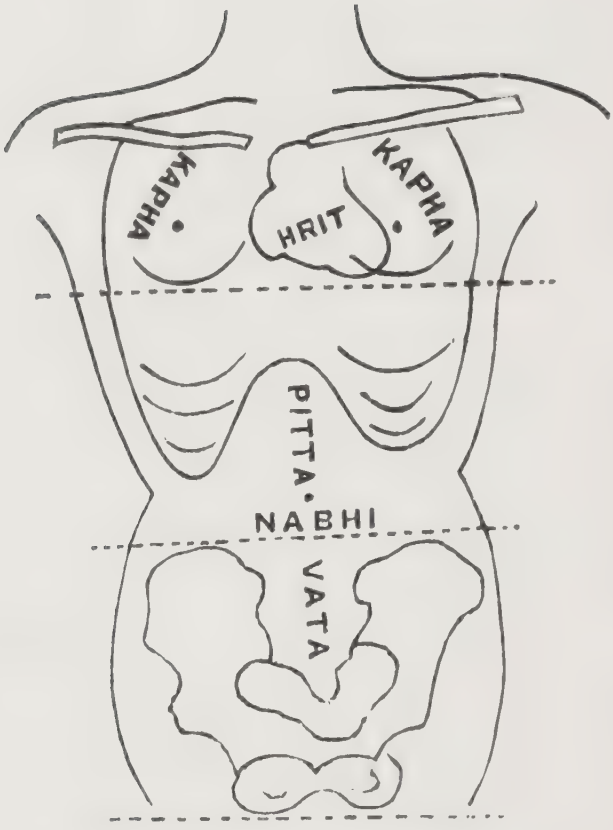
Their Role in the Maintenance and Impairment of Health

On the normal or disturbed equilibrium, as the case may be, of these three *doshās* depend health and ill-health respectively. In the words of *āchārya Vāgbhata.*

विकृताऽविकृतादेहं घ्नन्ति ते वर्तयन्ति च ।

"The *tridoshās* predispose the body to disease and decay when their equilibrium is disturbed. They contribute to the healthy state and the preservation and maintenance of health when their equilibrium is undisturbed."

In other words, the normalcy of *tridoshās* corresponds to the physiological states and the imbalance of the *doshic* equilibrium on the other hand, represent pathological states.



THE SEATS OF THE DOSHAS

The Main Seats of the Three Doshās

Vāta, pitta and *kapha* are to be found every where in the body—in the cells as in tissues, organs and systems.

There are, however, certain areas in the body which are stated to be their special seats. The area below the *nābhi* or umbalicus is the seat of *vāta. Pitta* is predominantly present in an area between the *nābhi* or umbalicus and *hrit* or heart, and *kapha* in the area above the heart.

ते व्यापिनोऽपि हृन्नाभ्योरधोमध्योर्ध्वसंश्रयाः ॥

The terms *nābhi* and *hrit* are anatomical land-marks to indicate areas in and near about them. The significance of these land-marks *vis a vis* the three *doshās* will be discussed in connection with the autonomous and vegetative nervous systems, digestion and absorption, pulmonary-capillary bed and tissue fluids, in a subsequent publication.

The Doshic Time

Vāta, pitta and *kaphā* have each their periods of preponderance and activity with reference to *vayas* or age (span of life), *ahas* or day, *rātri* or night and *bhukta* or food.

वयोहोरात्रिभुक्तानां तेऽन्तमध्यादिगाः क्रमात् ।

Doshas	Age or vayas	The day of 24 hours		Food or bhukta
		Day or ahas	Night or rātri	
Kapha	The first third of life-anabolic phase or the period of growth	Forenoon or the first third of the day	The first third of the night	After food and before the commencement of digestion
Pitta	The middle third of life or the period of physiologic equilibrium	The middle third of the day	The middle third of the night	During digestion
Vāta	The later third of life-katabolic period	The latter third of the day	The latter third of the night	After digestion

Agni and the Influence of the Doshās

The term *agni*, in common language, means fire. In physico-chemical, bio-physical and bio-chemical sequences, this term does not actually mean fire. In these contexts, it comprehends various factors which participate in and direct the course of digestion and metabolism in a living and physiologically functioning organism. *Agni* or fire is employed to cook food in order to render it fit for digestion. In physico-chemical processes *agni* (heat) is used to disintegrate, separate, and decompose substances, as also to accelerate various

kinds of chemical reactions. Similarly, the digestion of food in the *āmāsaya* and *pakwāsaya*, corresponding to to the stomach and small intestines, involving the splitting of complex food substances into their simpler components—proteins into amino acids; carbohydrates into glucose and fats into fatty acids and glycerol—so that they may be rendered fit for absorption, is made possible by the digestive juices containing powerful enzymes and harmones. All these put-together are spoken of as *agni*, or better still, *jātharāgni* or *koshtāgni*. They are also spoken of as *audarya tejas*. It is only when food substances are rendered fit for absorption into the system by *jātharāgni* that their metabolism can take place in the tissues all over the body.

Agni is of two kinds viz., (i) *jātharāgni* or *koshtāgni* and (ii) *dhātwagni*. While, as mentioned above, *jātharāgni* or *koshtāgni* is mainly concerned with chemical processes that take place in the gastro-intestinal tract, the more complicated and complex bio-chemical reactions to which the food snbstances absorbed from the gastro-intestinal tract are subjected — both anaerobic and aerobic—in the course of metabolic processes—katabolic and anabolic—are again due to very powerful enzymes and harmones secreted by the tissues. These, put together, are designated by a single term *dhātwagni*.[1] According to *Vāgbhata*, the subtle heat present in its own locus in all the tissues are responsible for the proper functioning of them and their develop-

1. स्वस्थानस्थस्य कायाग्नेरंशा धातुषु संश्रिताः ।
तेषां साधनि दीप्तिभ्यां धातु वृद्धिक्षयोद्भवः ॥
(Ash. Hri; Sutra 11; 34)

ment. The hyper functioning of this heat is stated to lead to the wasting or destruction of the tissues and the hypo-function to their increase. It is important to note that *Ayurveda* sees an interdependence between the *jāthara* (*koshta*) and *dhātwagnis*. In other words, it is held that, the proper functioning of the latter depends to a large extent on the proper functioning of the former. In the present context, the functioning of the *jātharā* (*koshta*)-*agni* under the influence of the one or the other of the three *doshās*, or a combination of any two of them, or all of them put–together, has been stated to occur as follows:

Vāta	Pitta	Kapha	The three doshās together
Vishama or erratic	Tikshna or intense (keen)	Manda or dull	Sama or normal

तैर्भवेद्विषमस्तीक्ष्णो मन्दश्चाग्निः समैः समः ॥

Prakriti or Temperament

शुक्रार्तवस्थैर्जन्मादौ विषेणैव विपक्रिमेः ॥
तैश्च त्रिस्रः प्रकृतयो हीनमध्योत्तमाः पृथक् ।
समधातुः समस्तासु श्रेष्ठा, निन्द्या द्विदोषजा ॥

In these words, *Vāgbhata* lays down the basis of *prakriti*, which in modern parlance, corresponds to the *temperament* or *personality*. The term *prakriti* means *swabhāva* or the nature of the individual. The definitions of the term temperament are :

i. That which constitutes, distinguishes and characterises a person apart from others of his kind in respect of his physical and

psychological make-up and reactions to his environment or surroundings.

ii. The peculiar physical character and the mental cast of an individual.

iii. The individual characteristics manifested by acts, feelings and thoughts etc.

In the *sloka* mentioned above, *ācharya Vāgbhata* says:

The *prakriti* of the child (to be born) is determined at the time of its conception (among other factors) by the state of the *doshās* in the *sukra* and *arthava* of the parents at the time of the act of fecundation. The *doshās* have been described as being susceptible to imbalance or vitiation. In this state, they may lead to the destruction of the health or cause decay and death. If so, the question may be asked, as to how they can cause or allow the conception to take place, or the *prakriti* i.e., the pattern of the temperament of the child (to be born) laid down. Such and other questions have been answered on the analogy of the birth, growth and development of *vishakrimies* (toxic-microbacterium) from the material of the toxin or *visha* itself instead of leading to their destruction. In the same manner, the *doshās* which are susceptible to vitiation and which may also vitiate the *sukra* and *ārthava* of the parents do not destroy the embryo. Instead, under the influence of the *doshic* states of the parents at the time of fecundation, three *prakrities* are stated to arise in the following manner:

i. If *vāta* is the dominating factor, then the basis of *vāta-prakriti* is laid down in the embryo.

ii. If *pitta* is the dominating factor, then the basis of *pitta-prakriti* is laid down in the embryo.

iii. If *kapha* is the domininating factor, then the basis of *kapha-prakriti* is laid down in the embryo.

The first type of *prakriti* i.e., the *vāta-prakriti* has been described as the *hina–prakriti* or weak temperament; the second i.e., *pitta–prakriti* as the *madhya* or mediocre temperament and the third i.e., *kapha-prakriti* as the *uttama* or the best and strong temperament.

If, on the other hand, a combination of any two of the three *doshās* happen to dominate in the parents at the time of conception, there is stated to arise the temperament described as the *nindya–prakriti* or an undesirable temperment.

When all the three *doshās* are equally dominant, there is then stated to arise the temperament described as the *sannipāta–prakriti*.

According to *ācharya Vāgbhata*, the other factors which contribute to the formulation of the *prakriti* or temperament are the states of the *doshās* in:

i. the *sukra* and *ārthava* (the reproductive elements of the male and the female respectively) at the time of conception;

ii. the womb, diet, mode of living and other activities (physical and mental) of the mother during the period of her pregnancy and

iii. the time factor i.e., ths season of the year in respect of the development of the foetus in the womb.

Says *Vāgbhata*:

शुक्रासृग्गर्भिणीभोज्यचेष्टागर्भाशयर्तुषु ।
यः स्याद्दोषोऽधिकस्तेन प्रकृतिः सप्तधोदिता ॥

(Ash. Hri; Sari 3 ; 83)

Due to factors mentioned above, seven kinds of *prakritis* have been stated to arise viz.,

i. *Vāta-prakriti,*
ii. *Pitta–prakriti,*
iii. *Kapha–prakriti,*
iv. *Vāta pitta-prakriti,*
v. *Vāta kapha-prakriti,*
vi. *Pitta kapha-prakriti,*
vii. *Sannipāta-prakriti.*

DESCRIPTION OF THE PATTERNS OF PRAKRITI[1]

Vāta prakriti: Persons who are of *vāta-prakriti* are lean and unsightly. Their body surface is rough and dry. They have scanty or sparse hair. Their voice is harsh, weak, broken and indistinct. Their sleep is unsound. They talk much, are hasty, soon get excited, become subjected to fear, and change their minds quickly. They are quick to understand but their memory is not retentive. They dislike cold and their joints creak when they sit, stand or walk. They dislike cold, vain, jealous, cruel, thievish, ungrateful, fond of music and dance, and are impulsive. They are given to the biting of finger-nails and when asleep, to teeth–grinding. They walk fast and their bodies show prominent veins. In general, they possess little strength, are short-lived and infecund as regards offspring. They are not capable of much exertion; they are unsteady in their friendship and possess little wealth and few friends.

Pitta–prakriti: Persons classified under *pitta-prakriti* look ugly with wrinkles, baldness and grey hair.

1. Based on Charaka and Susruta Samhitas and Ashtanga Hridaya.

They are loose-limbed, soft and yellowish in colour. Their lips, finger-nails, palms and soles, palate, tongue and eyes are copper coloured. Freckles, moles, dark-spots and small eruptions are frequently present in their body. The signs of old age set quickly in them. Their digestion is keen; urine, sweat and stools are copious. and their bodies emit bad smell. They possess body-strength, sexual power and longevity in a moderate degree. They are intelligent, irritable, quarrelsome and indomitable. They possess good memory. They are averse to warmth and are seldom overcome with fear; possess wealth and are of a helping disposition. They are susceptible to stomatitis.

Kapha-prakriti: The bodies of persons belonging to this *prakriti* are oily, smooth, firm, compact and well-developed. They have agreeable and pleasant appearance. Their faces are cheerful, and voice melodious; appetite and digestion good and sexual propensities rather above the normal. They are slow in their activities; seldom become agitated or upset and are well-versed in sciences and arts. They are capable of bearing pain and fatigue, and are respectful towards their superiors. They are patient, broad-minded, of an amiable disposition, liberal and charitable, true to their word and obedient to their preceptors. They are strong, unselfish, grateful, forbearing, self-controlled and fond of sweet taste. They are slow in forming opinion and fast in their enmity, and unchanging in thier friendship. They suffer no viscissitudes of fortune and are generally prosperous in life. In fine, they possess long life, large fortune and fine health.

Dwandwaja-prakrities : These are three in number, viz., *vāta-pitta*, *vāta-kapha* and *pitta-kapha prakrities*.

The characteristics of each of these types are represented by a combination of the features of any two of the three *prakritis* constituting the combination.

Sannipāta prakriti : The traits in this pattern are represented by the combination of the characteristics of *vāta*, *pitta* and *kapha-prakritis*.

Modern trends in respect of temperament and personality

Personality and temperament have, during recent times, assumed considerable importance due to advances made in psychology in its many branches, including psychiatry, experimental psychology, biology (including neuro-physiology) and medicine. An outcome of such developments is the *psycho-somatic medicine*

One of the problems which the different branches of biological sciences have been called upon to solve is the problem of the temperament and personality corresponding to the concept of *prakriti* in *Āyurveda*. The question has been asked as to how personality is determined. Does the body determine the personality or does the personality in any way determine the physical make-up of the person ? There is a general tendency on our part, for example, to pass over an unpleasant grouping of qualities in a person on the ground that he is unfortunately the possessor of gastric or duodenal ulcer—a weakness or mishap to the physique, with the ensuing discomfort and pain which may affect the

personality. It is, on the other hand, commonly observed in medicine that strenuous, energetic, restless and ambitious personality or temperament is peculiarly susceptible to gastric and duodenal ulcers. It may be stated that "the personality of man writes its signature on the lines of his face."

The question posited above, whether the body determine the temperament or the personality in any way determines the physical make-up of the person, has been sought to be answered in terms of mutual or reciprocal influence in both directions.

According to Dr. Alexis Carrel, the factors of personality or temperament are interwoven in the organic, humoural and mental factors, which form an indivisible whole. He observes: "The mental, structural and humoural individualities blend in an unknown manner. They bear to one another the same relation as do psychological activities, cerebral processes and organic functions. They cause every man to be himself and nobody else."[1] The way in which these combine to make the whole, constitutes the temperament or personality–the factor that determines the characteristic individuality of a person, different from those of his kind. It is true that the gene in the reproductive cells of the parents determine the potentiality of the individual and it is perhaps equally true that the environment, diet, habits, upbringing etc., also contribute a great deal, either to actualise these potentialities or keep them dormant.

1. Alexis Carrel, "Man the Unknown." Pelican Books—1948 edition

The temperament or personality factor is both mental and physical or properly speaking psycho-physical. According to Jung, the former i.e., the mental or *psychic* is of two kinds, viz., *introvert* and *extrovert*. The physical aspects of temperament have been variously classified and described. The following are a few of them:

1. Laycock's classification:
   - (a) Sanguinous, (raktaja)
   - (b) Nervous, (vātaja)
   - (c) Billious, (pittaja)
   - (d) Phlegmatic, (kaphaja)
   - (e) Lymphatic. (rasaja)
2. Kretchmer's classification:
   - (a) Athletic pyknic,
   - (b) Aesthenic pyknic,
   - (c) Aesthenic dyspeptic.
3. Hurst's classification:
   - (a) Hyper-aesthenic (gastric diathesis),
   - (b) Hypo-aesthenic,
   - (c) Asthma and Migraine.
4. Pearson & Wylie's classification:
   - (a) Lymphatic (kaphaja; rasaja) and
   - (b) Neuro-arthritic (vātaja).
5. Hess and Eppinger's classification:
   - (a) Sympathetico-tonic and
   - (b) Vago-tonic

   } (vātaja)
6. Danielopolus classification:
   - (a) Ampho-tonic,
   - (b) Sympathetico-tonic,

(c) Vago-tonic,

(d) Ampho-hypo-tonic.

The examples of the different kinds of temperaments or personality cited above will suffice to illustrate the growing modern trends in biology (including psychology) to mark off persons from one another under distinct groups and sub-groups, each with its own type of inherited physical and mental traits which largely determine their life activities in health and disease. These trends believe that the temperament or personality of a person is determined by the chromosomes and genes of the parents, or in other words, it is held that the probable carriers of hereditary potentialities are the chromosomes and genes (the reproductive elements of the parents).

Every cell – male or female—has chromosomes and genes. The chromosomes form the darkened nucleus which contain the genes. The genes are considered to be the main deciding factors as to what every living thing or human being shall be. The protoplasm is the most wonderful substance that surrounds them both. The genes are so infinitesimal that if all of them which are responsible for all human beings on earth to-day, with their individuality, psychology, colour and race could be collected and put in a place, they may be less than a thimbleful. These ultra-microscopic units are stated to hold the key to all human, animal and vegetable characteristics.

It is important to note that the genes are part of the sex cells and they do not take part in the general

body building. They are segregated and are considered not to participate in any of the less important activities of living things. They preserve the complete identity of the race. They do not seem to be influenced by the behaviour of the parent except that bad character, disease or accident may give them poor materials to work with. So much so, a strong pair of parents may have strong children, but this is because there were strong ancestors. "Parents may give a child a physical temple to live in or a sewer which is no place for an 'immortal soul'."[1]

Important as the chromosomes and genes are for the determination of the temperament, the physical, organic, humoural, the mental states of the parents are no less important. The inherited features and constitutional peculiarities of persons are held by authorities entitled to opinion, to be dependent on the peculiar mode of the mixing or combining of his inherited 'humours or essences. "While the time is not yet ripe for dogmatic statement" says that distinguished British physician, Dr. Leonard Williams, "there is a large mass of evidence which goes to show that the ductless glands, the endocrines with their essences, their hormones, as they are called, constitute the mainspring of this surprising mechanism; nor does the importance of the endocrines stop here, for, according to the exact proportion in which their essences are admixed in your blood, you are tall or short, dark or fair, phlegmatic

1. Cresey Morrison 'Man does not stand alone' Fleming H. Revell Company, New York, publication.

or choleric, saint or sinner, sexual, homo-sexual or sexless, male or female "[1]

The observations of Prof. Goddard are even more significant. He says in his Psychology of the Normal and Abnormal (vol II, page 269), "Cannon's and Crile's discoveries and other works with the ductless glands made it entirely possible that, while we may not be dealing with blood, yellow-bile and whatever fluids the ancients thought of under the name of black-bile and phlegm, we may nevertheless be dealing with such fluids as are secreted by adrenal glands, thyroid glands, thymus and other glands of internal secretion. It would seem quite probable then, that we are to think of different individuals as having inherited different constitutions in these particulars."

Ayurveda holds that not only do the reproductive elements of the parents and their physical and mental states contribute to the determination of the *prakriti* of the child to be born, but the pre-natal states of the mother also go a long way to influence the *prakriti* of the child. This will become obvious from the *do's* and *do not's* prescribed by *Vāgbhatāchārya* to a pregnant woman. Says *Vagbhata:*

उपचारः प्रियहितैर्भर्त्रा भृत्यैश्च गर्भधृक् ।
नवनीतघृतक्षीरैः सदा चैनामुपाचरेत् ॥

(Ash. Hri; Sari, I; 43)

In order that the pregnant woman may go through pregnancy safely bearing the strain of it and give birth to *a healthy child with a healthy mentality*, "her husband,

1. British Journal of Psychology, Medical Section,, Vol. II, P. 262.

servants (or nurses) should serve and nurse her with affection and beneficial measures. She should be nourished adequately with butter, ghee and milk."

The *āchārya*, then proceeds to lay down the *do-not's*, as follows :

अतिव्यवायमायासं भारं प्रावरणं गुरु ।
अकालजागरस्वप्नं कठिनोत्कटकासनम् ॥
शोकक्रोधभयोद्वेगवेगश्रद्धाविधारणम् ।
उपवासाध्वतीक्ष्णोष्णगुरुविष्टम्भिभोजनम् ॥
रक्तं निवसनं श्वभ्रकूपेक्षां मद्यमामिषम् ।
उत्तानशयनं यच्च स्त्रियो नेच्छन्ति तत्यजेत् ॥
तथा रक्तस्रुतिं शुद्धिं वान्तमामासनोऽध्वमान् ।
एभिर्गर्भः स्रवेदामः कुक्षौ शुष्येन्म्रियेत वा ॥

(Ibid 44–47)

The following are contra-indicated in pregnancy: " Over-indulgence in sexual acts ; physical exercise ; acts which result in exhaustion ; the carrying of heavy loads (on the head) ; the covering of the body with thick blankets or the wearing of heavy apparels; keeping awake during nights or sleeping in the day time; sitting on hard seats or be huddled up ; grief, anxieties and worries ; fright, anger, apprehension, wilful and forced suppression of natural urges (such as defecation, micturition etc.) ; the suppression of desires (or cravings) ; fasting (or starvation) ; walking long distances ; the consumption of articles of diet which are sharp and hot in potency and which are capable of binding the bowels (constipating) ; the suppression of micturition ; living in isolation ; looking into deep wells and pits ; the indulgence in alcoholic drinks; the ingestion of flesh and lying on the back. Pregnant women should also avoid factors

which the more experienced women have found to be harmful. In addition, measures as venesection (blood-letting), the administration of emetics and purgatives and such other radical therapeutic measures should (as far as possible) be avoided till the eighth month of pregnancy, in order to avoid abortion and miscarriage, mummification or the death of the foetus in the womb."

It has to be noted here that "factors which increase (or vitiate) *vāta* may contribute to malformations or deformities, such as scoliasis or hunch-back in the foetus and make it blind (or affect its vision), lethargic and dwarfish. The vitiation of *pitta* may contribute to allopacia or baldness of the head and yellow pigmentation of the skin of the foetus. If, on the other hand, *kapha* is vitiated, then it may result in albinism or white pallor of the skin."

The importance of the foregoing observations of the *āchārya* in respect of the influence of pre-natal vicissitudes of the mother in the determination of the physical make-up and mental outlook of the child to be born, becomes emphasised to-day in view of some recent developments in the field of the infant science *psycho-somatic medicine*, as may be gathered from the following observations of Dr. Flanders Dunbar of the Columbia University, College of Physicians and Surgeons.

This authority observes : "The creation of a sound mind begins at the same time as the creation of a sound body. Of course, there are hereditary factors which go back, perhaps as far as mankind, but these are a little

outside our scope. Almost from the moment of conception and in a way even before that, the factors in which psycho-somatic medicine has a special interest are present.

"As yet no one knows very much about the effect upon the child of the mother's mental and emotional experiences during pregnancy. We are swinging back now to a realisation that there is such a thing as pre-natal influence and we must set ourselves the task of finding out what it is.

"Enough is known to prove that both physical and mental characteristics depend to some degree upon experiences in the pre-natal period. For instance, the embryo is sensitive to sound. Loud unexpected noises cause the unborn heart to beat faster and it is even possible to set up a conditional reflex based on a particular kind of racket. Repeated disturbances of this kind use up energy which might go into building body and nerve tissue.

"There is also good reason to believe that if the mother is subjected to severe emotional strain during pregnancy, it may have an effect on the unborn child. This may be, in part because of a change of nourishment due to chemical reactions; it may be in the transmission of more subtle influences between mother and child.

"However, pending a good deal more of research in the field of human reproduction, we may take it that birth is where a beginning should be made in building a sound mind and sound body. We may

assume that the basic material has emerged from vicissitudes of heredity and pregnancy."[1]

The Characteristic Properties of the Tridoshās

The characteristic properties of the *tridoshās* or the *function-triad* are as follows :

Vāta : *Rūksha* (dryness), *laghu* (levity), *sita* (coolness), *khara* (roughness), *sūkshma* (subtleness) and *chala* (vivacity).

Pitta : *Sneha* (oiliness), *tikshna* (keenness or sharpness),

ushna (hotness) ; *laghu* (levity), *visra* (possessing a characteristic fishy smell), *sara* (fluidity) and *drava* (liquidity).

Kapha : *Snigdha* (viscosity), *sīta* (coolness), *guru* (heaviness or gravitation), *manda* (dullness and opacity), *mrisna* (slimy) and *stira* (fixed).

तत्र रूक्षो लघुः शीतः खरः सूक्ष्मश्चलोऽनिलः ।
पित्तं सस्नेहतीक्ष्णोष्णं लघु विस्रं सरं द्रवम् ॥
स्निग्धः शीतो गुरुर्मन्दः श्लक्ष्णो मृत्स्नः स्थिरः कफः ।

The Mode of Combination of Tridoshās in Abnormal States

When any two of the *tridoshās* together mark either a decrease or become vitiated, then such states are

1. Dr. Flanders Dunbar "Psychosomatic Medicine" p. 304.

known as *samsarga*. On the other hand, when all the three *doshās* are vitiated then such states are known as *sannipāta*.

संसर्गः सन्निपातश्च तद्विज्ञेयकोपतः ॥

The Seven Dhātūs or the Basic Tissues of the Body

The term *dhātu*, it was seen, is applicable to the three-fold functions of the body or the *tridoshās* as well as to the seven basic tissues or the *sapta dhātūs* that support the body in their states of normalcy. The seven basic tissues referred to here are :

(1) *Rasa* : The term *rasa* in the context of digestion means the chyme or chyle i.e., the end-product of gastro-intestinal digestion representing the nutritive elements which not only furnish materials for the building up of the tissues of the body but also the energy required for the body to work. It also means lymph as well as the tissue fluid.

(2) *Asrik or rakta* corresponds to the blood tissue ;

(3) *Māmsa* corresponds to the muscle tissue ;

(4) *Medas* corresponds to the adipose tissue ;

(5) *Asti* (including *tharunāsti or cartilage*) corresponds to the bone or os tissue ;

(6) *Majja* corresponds to the bone-marrow (red) ;

(7) *Sukra*[1] represents the reproductive elements of the male ;

1. Artava or sonita in the female, corresponds to sukra or the reproductive elements in the male.

In abnormal states of these basic structural elements-engendered by faulty *doshās* or functions, the *sapta dhātūs* are spoken of as *dūshyās*, much in the same way as the *tridhātūs* are known as *tridoshās* in similar disturbed states.

रसासृङ्मांसमेदोऽस्थिमज्जाशुक्राणि धातवः ।
सप्त दूष्याः..... ॥

It is neeessary to note here that the disturbed functional states may contribute to the pathological involvement of the concerned structures or *dhātūs* and *vice versa*.

Malās or Waste-Products

The term *mala* means waste-products and excrements. The main excrements (gross) of the living body are : *mūtra* or urine : *sakrit* or faeces and *swedādaya* or sweat etc.

मला मूत्रशकृत्स्वेदादयोऽपि च ।

By the term *ādayo api cha* is understood ' et cetera also '. It implies waste products which arise in the wake of the evolutionary metamorphosis of the consecutive *dhātūs* from *rasa* to *sukra*. It also comprehends the waste-products incidental to life-process all over the body, some of which are constants of the tissues in living states and are included in modern physiology in the group of cytoplasmic substances, known as non-protoplasmic inclusions e.g., carbon di oxide, urea, and the rest.

The General Principles Which Govern the Increase and Decrease of the Tridoshās, Sapta-dhātūs and Malās

The *tridoshās*, *saptadhātūs* and *malās* qualitatively and quantitatively mark an increase by the use of

substances possessing homologous properties and actions. On the other hand, the use of antagonistic substances i.e., substances possessing properties and actions opposite of the *doshās* and *dhātūs* generally influence their decrease.

वृद्धिः समानैः सर्वेषां विपरीतैर्विपर्ययः ।

The general principle envisaged above can be illustrated as follows :

(a) *Homologous substances :* The use of blood (or the essential elements of blood) influences an increased production of blood. The administration of flesh contributes to the increase of muscular strength and the growth of the body. The use or the administration of haemopoietic principles in modern medicine to stimulate blood formation, is an apt example of this principle. Similarly, animal flesh which is known as first class protein and which contains, what are known as essential amino acids, are esteemed valuable for the building up of the tissues of the body, especially the muscle tissue. The use of either cold water or milk which possesses homologous properties to *kapha* tends to increase this *dosha.* Both these substances contribute to the formation of tissue-fluids and the maintenance of water-balance in the body.

(b) *Identical qualities or gunās :* Plantain fruits, dates etc., which in appearance impress us as being essentially *pārthiva* in constitution, contribute to an increase of *kapha* which is *āpya* and *pārthiva* in compositions.

(c) *Homologous actions :* (i) Vigorous bodily exercises, such as running, riding, climbing etc ; (ii)

sleep, relaxation and rest etc., and (iii) emotional disturbances such as anger, rage, anxiety etc., tend to increase *vāta*, *kapha* and *pitta* respectively.

Advances in modern physiology have shown that vigorous physical exercise involving muscular exertion, result in fatigue and that fatigue is really not a matter that pertains to the muscle fibre proper but to the terminal arborisations of the motor nerves in the neuro-muscular end-plates in the fibre. In regard to number (ii) above, sleep, relaxation and rest tend to the conservation of the tissues and the promotion of anabolism. As regards number (iii) above, advances made in neuro-physiology, psychology and endocrinology shows that acute emotional states involving tensions, conflicts, anxieties, apprehensions, suppressions etc., tend to bring about an imbalance in the endocrine equilibrium, which in its turn, causes increased i.e., hyper-activity of some glands, such as the adrenals, and the lowered activity of other glands, such as the pancreas, leading to the production of symptoms attributed to the increase or decrease, as the case may be, of *pitta dosha*.

Shadrasās or six tastes

Tastes of substances, according to *Ayurveda*, are six in number. They are :

(1) *Swādu* (*madhura*) or sweet ;
(2) *Amla or sour i.e., acid ;*
(3) *Lavana* or saltish ,.e. saline ;
(4) *Tikta* or bitter ;
(5) *Ushana* (*katu*) or pungent i.e., acrid ;
(6) *Kashāya* or astringency.

Of these, each consecutive *rasa* from below upwards possess relatively greater strength than the preceding ones.

रसाः स्वाद्वम्ललवणतिक्तोषणकषायकाः ॥
षड् द्रव्यमाश्रितास्ते च यथापूर्वं बलावहाः ।

The above concept may be presented as follows :

Ūshana (*katu*) is stronger than *kashāya*;
Tikta is stronger than *ūshana;*
Lavana is stronger than *tikta;*
Amla is stronger than *lavana*;
Swādu is stronger than *amla*.

तत्राद्या मारुतं घ्नन्ति त्रयस्तिक्तादयः कफम् ।
कषायतिक्तमधुराः पित्तमन्ये तु कुर्वते ॥

THE ACTIONS OF RASĀS ON THE TRIDOSHĀS

Of the six *rasās*, the first three viz., *swādu*, *amla* and *lavana* are *anti-vātic;* the last three viz., *tikta*, *ūshana* and *kashāya* are *anti-kapha*, and *kashāya*, *tikta* and *madhura* are *anti-pitta*. The table furnished hereunder will be self-explanatory.

Anti-vātic	Anti-pitta	Anti-kapha
Swadu or sweet	*Kashaya* or astringency	*Tikta* or bitter
Amla or sour (acid)	*Tikta* or bitter	*Katu* or acrid
Lavana or saltish (saline)	*Madhura* or sweet	*Kashaya* or astringency.

In the reverse direction, *tikta*, *ūshana and kashāya* promote *vāta; amla, lavana* and *ūshana* promote *pitta* and *swādu, amla* and *lavana* promote *kapha*, as may be gathered from the table furnished below :

Promotes vata	Promotes pitta	Promotes kapha
Tikta	*Amla*	*Swadu*
Katu	*Lavana*	*Amla*
Kashaya	*Ushana*	*Lavana*

Three Varieties of Dravyās or Substances

Substances are classified into three categories from the point of view of their therapeutic properties. They are :

(i) *Samana* or palliative : Substances belonging to this group alleviate the disturbed *doshās* and restore them to their normalcy.

(ii) *Kopana* or provocative : Substances belonging to this group provoke the *doshās* ;

(iii) *Swasthahita* : Substances belonging to this group are beneficial for the maintenance of health.

शमनं कोपनं स्वस्थहितं द्रव्यमिति त्रिधा ॥

Virya

According to *Ayurveda* there are two *viryās*, namely, *ushna* or hot and *sita* or cold.

उष्णशीतगुणोत्कर्षात्तत्र वीर्यं द्विधास्मृतम् ।

The term *virya* means 'power', 'potency' etc. But, in the context of science or *vignāna*, *Charaka's* definition of it will hold good. He defines *virya* as "the power which performs work or action." "There is no action" says *Charaka* "which is not due to *virya*. All actions take place only because of *virya*."

.....वीर्यं तु क्रियते येन या क्रिया ।
ना वीर्यं कुरुते किंचित् सर्ववीर्यकृता क्रिया ॥

(Charaka; Sutra 26; 64)

This definition and description of *virya* should remind us of the modern definition of energy viz., "the energy of a body is its capacity for doing work and the measure of energy is work." In chemical changes "energy is liberated or absorbed, usually as heat, and occasionally as light, electricity or work. In reactions, where energy change is not great, all energy appears as heat, unless gas is formed." Energy may be potential or kinetic. Described in terms of *virya*, the former is *sita* and the latter *ushna*. The chemical energy locked up (or potentially held) in the food substances represents *sita-virya*. Substances from which energy is readily released in *pāka-karmās* under the influence or the action of *kāyāgni* (or bio-chemical reactions) involving oxidation, which in part manifests as heat, are *ushna* in *virya*.[1] This subject will again be dealt with in greater detail at a later stage.

Vipāka

The term *pāka* generally means 'to prepare', 'to render fit', 'to cook', 'to digest etc.' The term '*vipāka*' means *visesha* or *visishta-pāka*. According to the *Nyāya Vaiseshika* system, the term *pāka* signifies chemical reactions of different kinds. In the context of *Ayurveda* or biological science, this term comprehends various chemical reactions to which food and medicinal substances are subjected to in the *amāsaya-pakvāsaya* during the process of digestion and absorption, and in

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1. यद्यपि कायाग्निपाकादृष्टौ गुणा जायन्ते, तथाप्युष्णशीतयोर्गुणयोरुत्कर्षापकर्षाभ्यां वैविध्यम्। गुणान्तरविरोधे शक्तिरुत्कर्षः। शक्नुयात्कर्षे वीर्यशब्दो लोकेऽपि प्रसिद्धः। तत्र द्रव्ये। वीर्यमपि द्रव्याश्रयमित्यर्थः।

(Ayurveda Rasayana commentary on Ashtanga Hridaya)

the tissues (*dhātūs*) all over the body in the course of metabolism in which various kinds of powerful chemical substances, such as enzymes, harmones, oxygen etc., take part. *Āhārapāka*, for instance, is the process by which complex food substances are split into their simpler components, rendering them fit for being absorbed into the system. This will, in other words mean, the splitting of the three main organic fractions of food substances viz., the carbohydrates, fats and proteins in the digestive tract into their simpler components i.e., glucose or dextrose; glycerol and fatty acids, and amino acids respectively. It will be seen that this process does not involve any kind of chemical change in the food substances. Whatever change that takes place in these substances during digestion is merely a physical change. This change is known, in the language of *Āyurveda* as the *avasthā pāka*, implying a change only in the *avastha* or the aspect or form of the substances, and not in its chemical composition. The tastes of substances do not, in this process, undergo any radical change except perhaps for slight deviation of the original pattern of the substances involved. The change in tastes in *avasthāpāka is* as shown hereunder.

AVASTHĀPĀKA

Taste	Vipāka
Madhura	Madhura
Amla	Amla
Lavana	Madhura
Tikta	Katu
Katu	Katu
Kashāya	Katu

त्रिधा विपाको द्रव्यस्य स्वाद्म्ल्कट्कात्मकः ॥

In the *nishtāpāka* or the highly complex chemical reactions implied in the tissue metabolism of the end

products of the gastro-intestinal digestion, there occur radical changes in the products of the reactions involving change in their tastes at every stage and in every step. The final outcome of such changes in the taste of digested substances is as shown in the table below:

NISTĀPĀKA

Taste of substances	Anabolic	Ketabolic
Madhura	Madhura—>	Amla <—> Katu
Amla	Amla—>	Amla <—> Katu
Lavana	Madhura—>	Katu
Tikta	Katu—>	Katu
Katu	Katu—>	Katu
Kashāya	Katu—>	Katu

जाठरेणाग्निना योगाद्यदुदेति रसान्तरम्।
रसानां परिणामान्ते स विपाक इति स्मृतः ॥
स्वादुः पटुश्च मधुरमम्लोऽम्लं पच्यते रसः।
तिक्तोषणकषायाणां विपाकः प्रायशः कटुः ॥

This subject will be pursued in greater detail at a later stage.

GUNĀS OR QUALITIES OF DRAVYĀS

By the term *guna* is meant quality, mode, property predicament etc. In the context of both the *Nyāya-Vaiseshika* system and *Āyurveda*, *gunās* or qualities inhere inseparably i.e., are *samavāya*, in *dravyās*. According to the former system, *dravya* is the first of the six *bhāva-padārtās*. The remaining *bhāva-padārtās*, such as *guna*, *karma*, *samānya*, *visesha*, and *samavāya* also pertain to *dravya*. *Dravyā* has been defined by *Charaka* as "the substrate of *guna* or quality, *karma* or action and *samavāyi kārna* or inherent cause."

यत्राश्रिताः कर्मगुणाः कारणं समवायि यत्।
तत् द्रव्यम् (Charaka: Sutra 1; 51)

The category *dravya* comprises of nine substances of which *prithvi*, *ap*, *tejas*, *vāyu* and *manas* are *anūs* or atomic in structure, while *ākāsa*, *kāla*, *dik* and *ātma* are *vibhu* or continuum. We are here concerned with the first four of the *dravyās* which are atomic in structure or *anūs* and with which all substances—organic and inorganic—are composed. These atoms do not in nature, occur in uncombined or pure state, in the same manner as atoms of hydrogen, oxygen, carbon, nitrogen, etc., do not occur in free or pure state. They occur as compounds.

We understand substances only because of their qualities as these impress us by and through our senses. The qualities or *gunās* of compound substances reflect those of their molecules. The qualities of molecules are determined not only by those of the atoms that compose them but also the manner or mode in which they combine in substances. Their qualities are mutually determining. In other words, the qualities implicit in the elemental substances which are designated as the *kārana* or cause, become actualised in the *kārya* or effect i.e., the substances which arise as the result of the combination and permutation of *paramānūs*. This is based on the principle, "The properties that exist in the causative factor are seen to mani fest in the resultant factor."

कारण गुण पूर्वकः कार्यगुणो दृश्यते ।
कारणगुणपूर्वकं कार्यं दृष्टमकारणगुणपूर्वकं च दृष्टम् ।

(Sarvangasundara commentary on Ashtanga Hridaya)

It will follow from this that *gunās* or qualities which characterise the *kārana dravyās* or the atoms of elementary substances as belonging to particular generic

or *samānya*[1] group represent the permanent, indestructable and unchangable substantive qualities of the *anūs* or atoms thereof. These *gunās* or qualities are designated as *nitya* or substantive. They are stated to be eight in number, viz.,

i. *Guru* or heaviness, density, gravitation ;
ii. *Snigdha* or viscosity ;
iii. *Hima* or cold ;
iv. *Mridu* or soft ;
v. *Laghu* or light, levity and the opposite of guru or gravity ;
vi. *Rūksha* or rough, uneven and the opposite of *snigdha* ;
vii. *Ushna* or hot, the opposite of *hima* ;
viii. *Tikshna* or keen, penetrating, sharp.

These *gunās* become actualised and manifest themselves when the atoms of elementaty substances are in action i.e., when they perform *karma*. Obviously,

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1. *Samanya* or gentic qualities are " those that are inherent in two or more substances jointly." These qualities are: *samkhya* or number, *parimana* or dimension (quantity), *prithaktva* or severality, *samyoga* or integration, *vibhaga* or disintegration, *paratva* or priority, *aparatva* or posteriority, *dravatva* (derived) or fluidity, *gurutva* or gravitation and *vega* or velocity.

संख्यादिरपरत्वान्तो द्रवः सांसिद्धिकस्तथा ।
गुरुत्व वेगौ सामान्यगुणा एते प्रकीर्तिताः ॥

(Bhasha Paricheda, 89 - 91)

As compared to *samanya gunas*, *visesha gunas* or special properties are defined as " those which are inherent in one substance only at one time and not in two or more substances conjointly." These are "*buddhi* or intellect, *sukha* or pleasure, *duhkkha* or misery, *iccha* or desire, *dwesha* or aversion *prayatna* or effort, *sparsa* or touch, *sneha* or viscosity, *dravatva* or fluidity, *adrishta* or unseen destiny, *bhavana* or memory and *sabda* or sound."

द्रव्य विभाजकोपाधिद्वय समानाधिकरणावृत्तिजातिमान् ।

(Ibid 53)

therefore, *guna* is to be understood as *karma* when the elementary substances are active.

Karma, according to the *Nyāya Vaiseshika* system signifies motions of substances—atomic, molecular and molar. It has been defined "as the unconditional cause of *samyoga*[1] and *vibhāga*[2] i.e., the change of place of a particle in both space and time.

All actions, work, effort, endeavour, operation and in one word, all *kriyās* or *vyāparās* are ultimately traced to the *parispanda* i.e., the whirling rotary motion lodged in the atoms of the matter-stuff, *bhūtās* organisms and mental organs, which are regarded by the *Sāmkhyās* as modes of *prakriti*, and which are subject to this kind of motion.

बुद्यादयो देहंत्यजन्ते देहान्तरं उपादत्ते इति तेषां परिस्पन्दः। शरीरपृथिव्यादीनां च परिस्पन्दं प्रसिद्ध एव।

(Vachaspathi, Karika 10)

The *Nyāya Vaiseshika* system holds that all forms of matter, except *ākāsa* which is *vibhu* (continuum) and which is marked by *nishkriya* or non-activity, are subject to incessant *parispanda*. This applies to *paramānūs* of *prithvi*, *ap*, *tejas* and *vāyu* as to the things of the *mahath*. The world at the bottom is an infinitude of continously whirling or vibratory particles of matter.

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1. and 2. The term *samyoga* and *vibhaga* are usually translated as conjunction and disjunction. These terms, however mean more than what they actually convey. They imply integration and disintegration; composition and decomposition; association and dissociation; synthesis and analysis, and anabolism and catabolism.

संयोगविभागाभिरपेक्षकारणम्।

(Prasastapada)

अनवरतपरिस्पन्दपरिमितपवनादिपरमाणवः । [1]

and

परमाणवः दिगतिर्शालत्वात् पतत्व व्यपदेशाः पतन्तीति । [2]

These *karmās* or motions are both *sūkshma* and *stūla*. The former, known as *atindriya* (or beyond the threshold level of our sensibility), is the ultimate form of physical activity. Five kinds of *karmās* or motions have been visualized viz., *utkshepana* or rectilenear upward motion; (ii) *apakashepana* or rectilenear downward motion; (iii) *ākunchana* or contraction; (iv) *prasārana* or spreading or dilation; and (v) *gamanāgamana* or various motions in all directions viz., curvilnear motion,[3] rotatory motion or *bhramana*, vibratory motion or *spandana*.[4] In this view, the *gunās* such as *sabda* or sound, *sparsa* or tacticle sensibility (including the sensation of heat, cold, pain, and pressure), *rūpa* or light, colour and form, *rasa* or taste and *gandha* or smell, arise on account of the motions of bodies and their *samyoga* with the five *indriyās* or exteroceptors. Even so, a large number of other *gunās* or properties of substances exhibited by compound substances manifest themselves on account of the *samyoga* or *vighbāga*, as the case may be, of the elementary particles in active

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1. Raghunatha.
2. Udayana, Kusumanjali; stavaka v.
3. यदानियतदिक्प्रदेशसंयोगविभागकारणम् ।

(Prasastapada.)

4. उत्क्षेपणादिशब्दैः अनवरुद्धानां भ्रमणं पतनस्पन्दनादीनां अवरोधार्तगमन ग्रहणं कृतम् । (Ibid)

and गमनत्वं जातिविशेषः भ्रमणरेचनस्पन्दनोर्ध्वज्वलनमनोगमनादिष्वपि ।

(Sankara Misra)

motion. In the same manner the physico-chemical reactions or *pākās* of substances exhibiting different properties arise on account of the *samyoga* and *vibhāga* of molecules of *dwānukās, tryānukās, chaturānukās* etc., in active motion or when they perform *karma*. All *gunās* exhibited by compound substances as well as those that arise during and as a result of *pākās* or physico-chemical reactions[1] are all known as *anitya* or transient.

The *gunās* exhibited by compound substances-both organic and inorganic (including *āhāra* or food and *aushadha* or medicinal substances)--as noted by the authorities of *Āyurveda*, are the following:

i. *Guru* or gravitation;
ii. *Laghu* or levity;
iii. *Manda* or dullness, opacity;
iv. *Tikshna* or sharpness, keeness, penetrating;
v. *Hima* or cold;
vi. *Ushna* or hot;
vii. *Snigdha* or viscosity;
viii. *Rūksha* or friction;
ix. *Slakshna* or smoothness;
x. *Khara* or roughness;
xi. *Sāndra* or solidity;
xii. *Drava* or liquidity;
xiii. *Mridu* or softness:
xiv. *Katina* or hardness;
xv. *Stira* or static, fixed;

1. It is interesting to note that according to modern notions of chemical combinations, the orbital electrons are involved in chemical changes. An atom may shed or acquire the requisite number of orbital electrons to attain a stable configuration. It must be noted that electrons in the atoms are in ncessant motion in eleptical orbits.

xvi. *Sara* or fluidity;
xvii. *Sūkshma* or subtle;
xviii. *Stūla* or gross;
xix. *Visada* or clear, or transparent;
xx. *Picchila* or pasty.

गुरुमन्दहिमस्निग्धश्लक्ष्णसान्द्रमृदुस्थिराः ।
गुणाः ससूक्ष्मविशदा विंशतिः सविपर्ययाः ॥

General causes which predispose to health and disease

Asātmendriyārtha samyoga and pragnāparādha: The world, perhaps owes to *Vāgbhata* as to *Charaka* and *Susruta*, the comprehensive as well as the profoundly scientific concept of health and disease as the ability or otherwise of the man to adapt himself to his environment. The ancient *āchāryā's* appear to have fully recognised the fact that while man who is an *epitome of the universe* is constituted with the self same material which constitutes his environment, he is still an individual apart from it—an observer and a participant in its events, as well as a subject to whom the universe outside serves as an object. It appears to have also been recognised that while man is a creature of his environment, he also contributes consciously and unconsciously, his own quota to the making of it.

The ancient description of the man as an *epitome of the universe* also implies that his body itself is the field of as many events as take place outside him in his external environment. In other words, man's internal and external environments influence each other reciprocally.

The two environments are mutually determining and they interact with one another. Not only does constant exchange of materials take place between the two, but constant adjustments also take place between them all the time. It may well be to state here that while man's environment stimulates the process of adaptation in him and conditions his internal environment suitably, this process proceeds in the reverse direction also almost simultaneously. It is when his internal environment is properly conditioned and harmonised with the external i.e., when it strikes an equilibrium that man is stated to be in healthy state or '*swasthāvastha.*' His inability or failure to adopt his internal environment with that of the external and strike an equilibrium results in an abnormal or pathological state of his health. i e., *aswasthāvastha.*

The external environment: The external environment of man is constituted by *kāla, artha* and *karma. Kala* or time, in the present context refers to *rutu* or seasons and *artha* to the objects of the senses. *Āyurveda* has resolved the environment which is constituted by material substances under five-fold *bhautic* classification on the basis of the generic properties of the structure of their constituent *paramānūs* or atoms.[1] Whatever may be the nature of the chemical composition of substances which constitute our environment, all of them have to be resolved ultimately into specific quantas of energy, corresponding to the minimal threshold stimuli of each one of the five special sences, firstly to enable us to cognise their existance; secondly

1. For details of the doctrine of panchabhutas refer to pages 81-85 of the Fundamental Principles of Ayurveda, Part II, by the author.

to effect suitable responses in the body, and thirdly, to determine our bio-physical and bio-chemical reactions to the fivefold external stimuli with a view to harmonise our internal environment with the external. *Karma* is action and events within and outside the body.

The *internal environment* of man—*the psycho-samatic complex*—is constituted by the three *doshās* or the '*function triad*', the *sapta-dhātūs* or the seven-fold basic tissues which form the substrate of the structure of the body; *malās* or waste-products which arise as result of the life process, and the *psyche* or mind as determined by the three *gunās* viz., *satva*, *rajas* and *tamas*, which represent both the structure and functions of the mind.

According to *Vāgbhata* "The hyper, hypo and perverse correlations of *kāla* i.e., seasons, *artha* i.e., objects of the senses, and *karma* i.e., actions, between them, are the general causes which engender abnormal states of health or *roga*."

कालार्थकर्मणां योगो हीनमिथ्यातिमात्रकः ।
.....विज्ञेयो .....रोगस्य कारणम् ॥

Says *Charaka* "The causes which engender disease states in man are the hyper, hypo and perverse correlations of *kāla*, *artha* and *karma*."

त्रीण्यायतनानीति – अर्थानां कर्मणः कालस्य चातियोगायोगमिथ्यायोगाः ।
(Charaka : Sutra 11; 37)

Arogya or the physiological state, on the other hand, arises out of "the proper correlations of these three factors"

सम्यग्योगश्च विज्ञेयो.....आरोग्यस्य कारणम् ॥ (Vagbhata)

Stated in terms of modern physiology and in the words of Anton and Carlson, "All physiological mechanisms constitute defence against disease, for, they function to preserve constancy in the internal environment, a balance between factors which if opposed spell disease and death" They have quoted the famous physiologist Claud Bernard who says: "All vital mechanisms, however varied may they be, have only one object, that of preserving constant the conditions of life."[1] This, we may note, is best secured by a proper correlation of the external environment with the internal through the medium of the special senses or the *gānendriyās* with *kāla*, *artha* and *karma*

As stated already, the term *kāla*, in the present context refers to seasons. *Vāgbhata* classifies seasons as six, viz., *sisira*, *vasanta*, *grishma*, *varsha*, *sarat* and *hemanta*,[2] each of the duration of two months commencing from *māgha māsa*, corresponding to February-March. *Charaka*, on the other hand, describes seasons as three viz, *sita*, *ushna* and *varsha*, corresponding to the winter, summer and rainy seasons. In a country like India which is a place of contrasts and diversity and where all the climates and seasons of the world are adequately represented, the description of seasons either as six or three will largely depend on the place of the residence of the describer. *Charaka*, for example,

1. Anton & Carlson: "The Machinery of the Body" Chicago University publication.

2. मासैर्द्विसंख्यैर्माघाद्यैः क्रमात् षड्ऋतवः स्मृतः ।
शिशिरोऽथ वसन्तश्च ग्रीष्मो वर्षाशरद्धिमाः ।।
(Ash. Hri; Sutra 3; 1)

appears to have lived and taught *Ayurveda* on the slopes of Himalayas in the extreme north and has described three seasons usual to that locality. *Vāgbhata*, on the other hand, is stated to have resided at Malabar in the extreme south-west of the peninsula, and he has described the seasons of that place as six. Whatever may be the difference between these two authorities in the classification of the seasons, most parts of the Indian peninsula have three seasons as described by *Charaka*, viz., *sita-kāla* or the cold season, *ushna kāla* or the hot season and *varshā kāla* or the rainy season, corresponding to *hemanta*, *grishma* and *varsha rutūs*.

शीतोष्णवर्षलक्षणाः पुनर्हेमन्तग्रीष्मवर्षाः संवत्सरः, सकालः ।
(Charaka, Sutra, Ch. II; 42 (i))

"The year consists of the three periods viz. winter, summer and the rains, characterised respectively by cold heat and wetness."

The ati (hyper), hina (hypo) and mithya (perverse) yogās (correlations) of kāla or seasons : Says *Charaka :* " If a season is marked by an exaggeration of its own characteristic traits, then it is spoken of as the seasonal excess ; if it is marked by a deficiency of its normal traits, it is then spoken of as seasonal deficiency and if the season is marked by traits contrary to its true nature, then it is spoken of as perverse seasonal abnormality. *Kāla* is again change.

तत्रातिमात्रस्वलक्षणः कालः कालातियोगः,
हीनस्वलक्षणः (कालः) कालायोगः, यथा
स्वलक्षणविपरीतलक्षणस्तु (कालः) कालमिथ्यायोगः ।
कालः पुनः परिणम उच्यते ॥
(Charaka Sutra: 11, 42)

The three kinds of correlations of the indriyās with their arthās

The sense of vision : The main object i. e., the *artha* or *vishaya* of the (sense) organ of vision is *rūpa* or light. The *atiyoga* or hyper-correlation of this organ is brought about by gazing at excessively luminous objects, such as the sun, flashes of lightning and the like for long durations. The *ayoga* or hypo-correlation of the eye is brought about by the total disuse of this organ. Its *mithya-yoga* or perverse correlation is secured by gazing at objects which are either very close or are far removed from the eyes, and the act of looking at aweinspiring or fearful, terrible, prodigious, hateful, monstrous and alarming sights.

तत्रातिप्रभावतां दृश्यानामतिमात्रं दर्शनमतियोगः, सर्वशोऽदर्शनमयोगः, अतिश्लिष्टातिविप्रकृष्टरौद्रभैरवाद्भुतद्विष्टबीभत्सनविकृत वित्त्रासनादिरूपदर्शनं मिथ्यायोगः । (Ibid)

The sense of audition : The object i. e., the *artha* or *vishaya* of the (sense) organ of hearing is *sabda* or sound. The *atiyoga* or hypo-correlation of the organ of hearing is to listen to sounds which are harsh, joy-killing, afflicting, humiliating, terrifying etc.

तथाऽतिमात्रस्तनितपटहोत्क्रुष्टादीनां शब्दानामतिमात्रं श्रवणमतियोगः । सर्वशोऽश्रवणमयोगः, परुषेष्टविनाशोपघातप्रधर्षणभीषणादिशब्दश्रवणं मिथ्यायोगः ।
(Ibid)

The sense of olfaction: The object i. e., the *artha* of or *vishayā* of the (sense) organ of smell is smell. Its *atī-yoga* or hyper-correlation is brought about by very sharp, keen, rank, and deliquescent odours or

smells; its *hinayoga* or hypo-correlation or disuse is engendered by not exercising the faculty of smell altogether, and its *mithyayoga* or perverse correlation is brought about by the smelling of odours as are putrid, hateful, unclean, poisonous, cadaverous etc.

तथाऽतीक्ष्णोग्राभिष्यन्दिनां गन्धानामतिमात्रं घ्राणमतियोगः; सर्वशोऽघ्राणमयोगः; पूतिदुष्टामेध्यक्लिन्नविषपवनकुणपगन्धाऽघ्राणं मिथ्यायोगः।

(Ibid.)

The sense of gustation: The object i.e., the *artha* or *vishaya* of the palate is taste or gustation. Its *atiyoga* or hyper-correlation is brought about by excessive indulgence of the palate; the *hinayoga* or hypo correlation of the palate is to abstain altogether from all tastes, and its *mithyayoga* or perverse correlation is brought about by transgressions of the rules pertaining to diet and its quantum.

तथा रसानामत्यादानमतियोगः, सर्वशोऽनादानमयोगः; मिथ्यायोगो गाशवज्यैष्याहारायधिविशेषायतनेषूपदेक्ष्यते; (Ibid)

The organ of tactile sensation: The object i.e., the *artha* or *vishaya* of the apparatus of tactile sensation is touch, contact or *sparsa*. Its *atiyoga* or hyper-correlation is exposure to extremes of temperature i.e., cold and heat; over-indulgence in baths and friction-massages etc. Its *hina-yoga* or hypo-correlation is the abstinance altogether of all tactile stimuli. Its *mithya-yoga* or perverse correlation is to indulge alternatively in cold and hot-baths and applications without having regard to their proper indications. It is also perverse correlation of this *indriya* to permit the body to suffer contact with uneven surfaces, trauma, unclean things and invisible organisms (*bhūtās*).

तथाऽतिशीतोष्णानां स्पृश्यानां स्नानाभ्यङ्गोन्मादनादीनां चात्युपसेवनमतियोगः, सर्वशोऽनुपसेवनमयोगः, स्नानादीनां शीतोष्णादीनां च स्पृश्यानामनानुपूर्व्योपसेवनं विषमस्थानाभिघाताद्युचिभूतसंस्पर्शादयश्चेति मिथ्यायोगः ॥ (Ibid)

Charaka makes here an extremely interesting and significant observation of value in neuro-physiology, psychology and psychiatry. He says "From among the senses, the tactile sense pervades all others and the mind is inherent in it, for, the field of the mind is co-extensive with that of the tactile sense."

तत्रैकं स्पर्शनमिन्द्रियाणामिन्द्रियव्यापकं, चेतः समवायि, स्पर्शनव्याप्तिव्यापकमपि च चेतः; (Ibid)

"Accordingly" says *Charaka*, "all sensory responses referable ultimately to the ubiquitous sense of touch, when it does not subserve the general ends of the organism, falls into the five-fold tripartite classification of non-homologatory combination of the senses with their sense-objects. For, whatever subserves the purpose of the organism as a whole, is homologatory combination of the senses and their objects."

तस्मात् सर्वेन्द्रियाणां व्यापकस्पर्शकृतो यो भावविशेषः, सोऽयमनुपशयात् पञ्चविधस्त्रिविधविकल्पो भवत्यसात्म्येन्द्रियार्थसंयोगः, सात्म्यार्थो ह्युपशयार्थः। (Ibid)

Karma: *Karma* is action and motion. In the present context, the term *karma* or action refers to the hyper, hypo and perverse correlations of *vāk* or vocal expression i.e., speech, mental activities, and the volitional functions of the body. "The over activity of anyone of these or all of them, or the total suppression of their activities are to be understood as their *ati* or *hinayogās* respectively.

कर्मवाङ्मनःशरीरप्रवृत्तिः। तत्र वाङ्मनःशरीरातिप्रवृत्तिरतियोगः; सर्वशोऽप्रवृत्तिरयोगः; (Ibid)

Body or soma: The perverse use or hyper-correlation of the body consists of wilful inhibition (or suppression) or excitation of the natural urges or forces; awkward stumbling; the falling or the posturing of the limbs, and the abuse of the body, such as putting it to unnatural uses; the infliction of injury to the body; violent kneading of the limbs, and the forced holding of the breath and similar kinds of self-mortifications.

वेगधारणोदीरणविषमस्खलनपतनाङ्गप्रणिधानाङ्गप्रदूषणप्रहारमर्दनप्राणोपरोध-संक्लेशनादिः शारीरो मिथ्यायोगः, (Ibid)

Vāk or vocal expressions: The *mithyāyoga* of *vāk* or speech is indulgence in a language that is insinuating, untrue, untimely, quarrelsome, unpleasant, incoherent, unhelpful, harsh etc,

सूचकानृताकालकलहाप्रियावद्धानुपचारपरुषवचनादिर्वाङ्मिथ्यायोगः, (Ibid)

Manas or *mental perversions*: Perversions or the misuse of the mind or *psyche*, comprise of the susceptibility to fear-complex, grief, anger, greed, infatuation, self-conceit, envy, deluded thinking and the rest.

भयशोकक्रोधलोभमोहमानेर्ष्यामिथ्याशीनादिर्मानसो मिथ्यायोगः ॥ (Ibid)

Stated in brief, "all activities of speech, mind and body, while not covered by overuse and disuse is unwholesome, though these may not have been specifically mentioned here, should be taken to mean the misuse or *mithya yoga* of the *psyche*."

संग्रहेण चातियोगायोगवर्ज्जं कर्म वाङ्मनःशरीरजमहितमनुपदिष्टं यत्तच्च मिथ्यायोगं विद्यात् ॥ (Ibid)

Thus, "the threefold activities i.e., of the *vāk*, *manas* and *sarira* covered by the three headings viz., *ati*, *hina*

and *mithya-yogās,* are to be considered as *pragnāparādha* or volitional transgressions."

इति त्रिविधविकल्पं त्रिविधमेव कर्म प्रज्ञापराध इति व्यवस्येत ॥ (Ibid)

Thus, "these three non-homologatory or *asātmya* contact of senses and their objects i.e., *asāthmendriyārtha samyoga ;* volitional transgressions or *pragnāparādha* and change i.e., *parināma* or *kāla,* each subdivided again into three, contribute the causes which either predispose or actually lead to abnormal states of health. The right or proper correlations of these, on the other hand, determine the physiological or normal states corresponding to *ārogya* or *swasthavastha.*"

इत्यसात्म्येन्द्रियार्थसंयोगः, प्रज्ञापराधः, परिणामश्चेति त्रयस्त्रिविधविकल्पा हेतवो विकाराणां ; समयोगयुक्तास्तु प्रकृतिस्थिरो भवन्ति ॥ (Ibid)

It will be seen from the foregoing, that between them, *asātmendriyārtha samyoga* and *pragnāparadha* constute the two vitally important factors which predispose or actually lead to disease states. Recent developments in the field of medicine and allied subjects appear to lead to conclusions similar to those of the ancient *Ayurvedic,* as reflected in the expositions of *āchārya Charaka* and *Vāgbhata* discussed above. For instance, an important outcome of the various factors enumerated under the heading *asātmendriyārtha samyoga* is the production of fatigue. "Fatigue, either of the body or mind" says Dr. John Drew, in his popular work on 'Man, Microbes and Malady',[1] "slows down the vital functions and thereby lowers the general

1. Dr. John Drew, 'Man, Microbe and Malady' Pelican book, 1950 edition.

resistence of the individual. The tired man cannot digest his food properly. The messages that are being continually flashed to his brain from all over the body meet with lethargic (or sleepy) response -the central telphone exchange is too drowsy to function properly for the time being. The result is the partial loss of that vital co-ordination of the various functions of the different tissues that is essential for a state of good health. Deprived of proper control, the different organs and tissues begin to compete against each other instead of working together as a team, and the result is that any inherent weakness in the make up of the individual is aggravated."

No less important is *pragnāparādha* in which the *rajas* (passion) and *tamas* (ignorance) of the mind take a leading part in the causation of *somatic* disturbances. It is necessary to note here that the terms *psychic* and *somatic* in the context of living states and life process are conventional ones used for convenience of description of the two vitally important and mutually determining aspects of the functions of higher organisms, though it may not be possible to draw a line between the two and state were the one ends and the other begins. Even assuming that these two aspects really have their own special sets of laws to govern them, still the interdependence of the two is so intimate, that to consider them as distinctly separate entities may prove to be an anachronism. This will become obvious from the fact that upheavals in the mind or the *psyche* may result in and can be understood by disturbances engendered in the *soma* and *vice versa*.

Pragnāparādha or conscious and wilful transgressions, especially those pertaining to the *manas* or the *psyche* (mind) and *vāk* have far-reaching consequences on the *soma*, leading to the manifestation on the physical side of various and often inexplicable kinds of disturbances, described variously as psychoses, neuroses etc. This idea runs right through and forms the substrate of the *Āyurvedic* concepts of the pathogenises of diseases.

Since the advent of Sigmund Freud in the nineties, a new branch of psychology which began with the psychology of the unconscious mind, investigated clinically cases of conditions included under the heading psychoses and neuroses, especially hysteria, and the latter field of normal psychology, especially the psychology of errors, forgetfulness, and humour. An entirely new approach to child psychology became the basis of the Freudian psycho-pathology and later on to *psycho-somatic medicine*. The latter branch of knowledge is based on the idea that physical signs and symptoms of diseases may be co-determined by emotional factors. At least 50% of cases in general practice are stated to belong to the field of *psycho-somatic medicine*.

The role of the mind in the causation of physical diseases has been vividly portrayed by Dr. John Drew in his book referred to above. He notes: "Worry is a state of mind that is difficult to define, because it differs in the individual, but its basic cause is fear, and fear is an emotion that has far-reaching effects upon the activities of the human body, accentuating some and depressing others. There are certain glands in the body

grouped together for convenience under the name of ductless glands that manufacture powerful and vital secretions. The thyroid, para-thyroid, pituitary, supra-renal and internal sex–glands secrete substances that not only regulate the growth and bodily activities of the individual, but also influence in some degree his behaviour and his reactions to environment. Activities of these glands are, in turn, affected by emotional states and while as yet we have no precise knowledge about the effect upon them of the emotion of fear, there is no doubt that they are affected and that the effect is probably "detrimental." "Emotion" observes Crile "causes a more rapid exhaustion than is caused by physical exertion or by trauma, except in extensive mangling of tissue or by any toxic stimulus except the perforation of viscera." [1]

Recent developments in psycho-pathology have shown that "many cases of diseases—organic and functional—are directly caused by mental states. The body became ill because the mind controlling it either secretly wants to make it ill or else because it is in such a state of agitation that it cannot prevent the body from sickening. Whatever its physical nature, resistance to disease is unquestionably correlated with the psychological condition of the patient." [2] The detrimental effects ascribed by Dr. Drew to worry and

1. Quoted by Vaidyaratna Capt. G. Srinivasamurti B.A. B.L., M. B. & C. M. in his Memorandum on "The Science and Art of Indian Medicine" contributed to the report of the Chopra Committee on Indigenous Systems of Medicine (1949), Part II' p. 354 f.

2. Ibid.

fear, apply with equal force to anger, grief, greed, infatuation, self-conceit, envy, deluded thinking and the rest comprehended by *āchārya Charakā's* description of the *mithya-yoga* of the activity of the *manas*.

Modern medicine is now prepared to explain that with every fit of anger etc., there will be a corresponding unhealthy stimulation of the adrenal or other glands, which if frequently repeated, may lead to the exhaustion of the concerned glands so as to result, for example, in diabetes, dyspepsia, gastric and duodenal ulcers, neurasthenia, hysteria etc. It appears that modern medicine is also prepared to look for even 'epidemics' of emotional disorders similar to 'epidemics' of physical disorders. A leading American medical authority recently expressed the view that "When stocks go down in New York, diabetes goes up." [1]

According to *āchārya Charaka*, "efforts should, therefore, be made by the following means to preserve the normalcy of the sense-organs and the mind, to protect them from abnormality."

तत्रेन्द्रियाणां समनस्कानामनुपतप्तानामनुपलोपाय प्रकृतिभावे प्रयतितव्यमेभिर्हेतुभिः;
(Ibid)

They are : "The wholesome contact of the sense-organs with their objects, the proper performance of actions after intelligent and repeated scrutiny and the resort to the habitual use of agents that counteract the prevailing traits of the climate, season and one's own constitution."

1. Ibid.

तद्यथा—सात्मेन्द्रियार्थसंयोगेन बुद्ध्या सम्यगवेक्ष्यावेक्ष्य कर्मणां सम्यक् प्रतिपादनेन देशकाल्यात्मगुणविपरीतोपासनेन चेति ।

(Ibid)

Disease or Roga and Health or Árogya

Health, according to a modern definition is "the normal state of living and functioning of the organism." But then, the criterion of normalcy is hard to state in so far as it relates to man. It has, in fact, not so far been satisfactorily defined or described. The living organism is, in the nature of things, in a state of flux, change and transformation which makes a satisfactory description of its normalcy rather difficult, as the yard-stick of the standard of judgment is an unchanging permanence. Certain amount of abnormality is incidental to the process of flux, change and transformation. This position is further complicated by the inherited and acquired charateristics and tendencies developed by living creatures consequent on the stress and strain of environmental vicissitudes and the urge to survive, which have necessitated various modes of adaptations and adjustments. Hence it has come to pass that the diversity and heterogeneity of forms, characteristics, tendencies, resistance and susceptibility to disease etc., distinguish individuals, families, societies and nations, as distinct and different from each other.

In view of the above, a more comprehensive description of health has recently been sought to be given, according to which, "health is a positive state of well being in which the harmonious development of the physical and mental capacities of the individual lead to the enjoyment of rich and full life" (Indian Planning

Commission). This description has, it is obvious, not improved the situation. Modern definitions and descriptions of health still remain vague. The need to derive a satisfactory dnfinition, rather than a laboured description of health, as can be applied to groups as to individuals has become very necessary.

It is in this context that the *Ayurvedic* definition of *ārogya* calls for a close examination. *Charaka* defines health as "a state in which the function-structure relationship is in a state of equilibrium. Disease is the imbalance of the function–structure relationship. The former state is characterised by a sense of ease and pleasure, and the later is always in the nature of pain."

विकारो धातुवैषम्यं साम्यं प्रकृतिरुच्यते ।
सुखसंज्ञकमारोग्यं, विकारो दुःखमेव च ॥

(Charaka, Sutra 8; 4)

According to *Vāgbhata* the state of *doshic* (function triad) equilibruim represents the disease-free-state.

.....दोषसाम्यमरोगता ।

In the reverse direction, the imbalance or the disturbed equilibrium of the *tridoshās* (function-triad) indicates pathological states.

रोगस्तु दोषवैषम्यम्.....।

In view of the above, *Ayurveda* has offered a comprehensive description of health, which can be applied with equal force to groups as to individuals, in the following terms :

"He is known as the *swastha* in whom the threefold functions of the body viz., *vāta*, *pitta*, and *kapha* are in a state of equlibrium; whose *agni* is in *samāvasta* and the *dhātūs* or the basic and supporting tissues are in a proper state of integrity; in whom the process of the elimination of the waste products of the body is regular and whose *ātma* (spirit), sense–organs and mind are clear and bright."

समदोषः समाग्निश्च समधातुमलक्रियः ।
प्रसन्नात्मेन्द्रियमनाः स्वस्थ इत्यभिधीयते ॥ (Susruta, Sutra 15, 41)

In other words, a *swastha* or a healthy individual is a person in whom the function-structure relationship is in a state of equilibrium ; whose hunger, appetite and digestion are not impaired or are faulty ; in whom the elimination of the excrements of the body are regular ; whose soul and mind are clear and tranquil, and whose sense organs function efficiently.

The application of this criteria of health is sure to differentiate the healthy from the unhealthy, the strong from the weak and the mentally sound from the unsound. Its value lies in the emphasis laid on the states of physical, mental and spiritual constituents of a healthy individual, which between them, serve as an index of his physical well being, fitness, resistance, and capacity to adapt himself to the ever-changing vicissitudes of his environment to the making of which, he in part makes a contribution. In the light of the modern description of health as a " positive state of well being in which the harmonious development of the physical and mental capacities of the individual lead to the enjoyment of rich and full life, " the ancient *Ayurvedic* description of the healthful state assumes considerable significance.

Two kinds of diseases

Diseases have been classified under two general categories viz., *nija* and *āgantuja*. Diseases classified under the *nija* group are stated to arise as a result of intrinsic disturbances in the *soma*, involving primarily the imbalance of the *tridoshic* equilibrium, such as metabolic and endocrinal disturbances, functional disorders, and so forth. Diseases classified under the *āgantuja* group are those which are primarily extrinsic in origin and which provoke secondary systemic reactions, resulting ultimately in the imbalance of the *tridoshās*. Injuries due to accidents and bacterial infections etc., are examples of *āgantuja* diseases. The latter type of diseases manifest themselves only after engendering the equilibrium of the *tridoshās*.

निजागन्तुविभागेन तत्र रोगा द्विधा स्मृताः ।

Two main seats of diseases—kāya or the soma and manas or the psyche.

According to the difference in the location of their causative factors, diseases have been classified as *kāya-rogās* i. e., diseases of *somatic* origin and *mānasika rogās* i.e., diseases *psychic* origin. The causes of the former type of diseases are purely *somatic* and the latter *psychic*.

तेषां कायमनोभेदादाधिष्ठानमपि द्विधा ।

The doshās of the manas or psyche

If the *tridoshās* represent the generalisation of the functions of the body under three broad-based classifications viz., *vāta*, *pitta* and *kapha*, which are constituted by

various modes of the combination of *panchabhūtās*, the constitution of the *psyche*, in its structure and function, has been described in terms of *trigunās* viz., *satva*, *rajas* and *tamas*. These three *gunās*, represent the three modes of the *Prakriti* or Matter. *Satva* stands for the capacity of the Matter to reflect *ātma* or intelligence, *rajas* for Energy; and *tamas* for Mass that offers resistance to *rajas*. The *tridoshās* on the *somatic* side, represent the condensation of these three qualities by which the Matter in its primordial state has been understood and described. The constitution of *vāta* is *ākāsa* and *vāyu*, and its function is *rājasic* i.e., activating or dynamic in nature; *pitta* is constituted by *tejas* and its function is *sātvic*, and *kapha* is constituted by *ap* and *prithvi* and its function is *tāmasic*. The *sapta-dhathūs* or the seven primary tissues of the body represent grosser compounds of *panchabhūtās*, and their functions can be described both in terms of *tridoshās* as well as *trigunās*. Likewise, the *manas* or *psyche*, known also as the *būddhi*, is a very subtle from of Matter, the structure and function of which have been described in terms of *trigunās*. There is, in these cases, an intimate and inseparable relationship between structure and function of a mutually determining character. In the context of the *manas* or *psyche*, therefore, *satva* represents the state of normalcy i.e., equilibrium, *rajas* passion and *tamas* inertia. The preponderance of *satva* over the other two *gunās* is to be inferred from the normalcy of the mental state. On the contrary, the *rajas* and the *tamas* which are susceptible to vitiation or imbalance have been described as the two *mānasika doshās*.

रजस्तमश्च मनसो द्वौ च दोषावुदाहृतौ

Examination of the rogi (patient) and roga (disease)

A salient feature of *Āyurveda* is the *modus operandi* prescribed for the examination of disease–states in terms of : (a) the *rogi* or patient and (b) *roga* or the disease he is suffering from. The aeteology, prodromata, and pathogenesis of diseases being in most cases atypical and characteristic, the constitutional peculiarities of the patient apparently go a long way in deciding the course they may follow and the way they may manifest. The examination of disease or pathological states with a view to diagnosis, should aim at the elucidation separately of factors relating to the patient and diseases which afflict him.

Rogi pariksha : Facts relating to the patient are to be elucidated by *darsana* or inspection, *sparsana* or plapation and *prasna* or interrogation.

दर्शनस्पर्शनप्रश्नैः परीक्षेत च रोगिणम् ।

The methods mentioned above are general. These are to be supplemented by :

I. *Ashtasthānapariksha* or the examination of the following eight factors : viz.,

(i) *nādi* or pulse ; (ii) *mūtra* or urine ;
(iii) *mala* or stools ; (iv) *jihva* or tongue ;
(v) *netra* or the eyes ; (vi) *sparsa* or skin ;
(vii) *sabda* or voice (throat) and
(viii) *rūpa* (*ākriti*) or the general condition or appearance of the patient ; and,

II. *Angapratyanga pariksha* or the examination of *shadangās* or the six anatomical divisions of the body, viz.,

(i) the head and neck ; (ii) the trunk ;
(iii) and (iv) the two upper extremities,
(v) and (vi) the two lower extremities and
(vii) *pratyanga* i.e., the eyes, heart and the visceral organs of the trunk etc.

Roga pariksha: The examination of the disease has to be done with a view to elucidate facts relating to :

a. *Nidāna* or aeteology of the disease in its nine aspects viz.,

(i) *sannikrishta nidāna* or proximate or exciting causes ;
(ii) *viprakrishta nidāna* or remote or predisposing causes;
(iii) *vyābhichara nidāna* or subservient or weak causes ;
(iv) *pradānika nidāna* or predominant or patent causes ;
(v) *asātmendriyārtha samyoga* or incompatible correlations of the special senses with their respective objects viz., hyper, hypo and perverse correlations ;
(vi) *pragnāparādha* or faults arising out of the wrong use of *vāk* or speech, *manas* or *psyche* and *sarira* or *soma* ;
(vii) *parināma* or time factor viz., seasons, climate etc ;
(viii) *ānubandya* or independent, and
(ix) *anubanda* or dependent etc.

b. *Pūrvarūpa* or prodromal symptoms ;
c. *Rūpa* or symptom-complex of the disease ;
d. *Upasaya* or diagnosis by applied therapeutics, and
e. *Samprāpti* or pathology and morbid anatomy.

रोगं निदानप्राग्रूपलक्षणोपशयाप्तिभिः ।

TWO KINDS OF DESA (SOIL AND ENVIRONMENT)

Desa or space (environment) can be classified as *bhūdesa* or the soil i.e., the external environment, and *dehadesa* or the body-soil i.e., the internal environment.

भूमिदेहप्रभेदेन देशमाहुरिह द्विधा ।

Bhūmidesa i.e., the soil or external environment has been classified under three categories, viz.,

(a) *jāngala* i.e., dry or arid ;
(b) *anūpa* or wet, moist and marshy ;
(c) *sādhārana* or *sama* i.e., salubrious.

जाङ्गलं वातभूयिष्ठमानूपं तु कफोल्बणम् ।
साधारणं सममलं त्रिधा भूदेशमादिशेत् ॥

Of the three kinds of soil and environment, *jāngala-desa* is characterised as a place of sparse vegetation, having few or no hills or mountains, rivers and lakes etc., in or near about. It is a place which can be aptly described as dry, arid, windy, waterless and sparsely vegetated. The incidence of diseases are few and far between in this environment. Such diseases as may occur in this environment are predominantly *vātaja* in nature.

देशोऽल्पवारिद्रुनगो जाङ्गलः स्वल्परोगदः ।
(Ash. Hri ; Sai 3 ; 79)

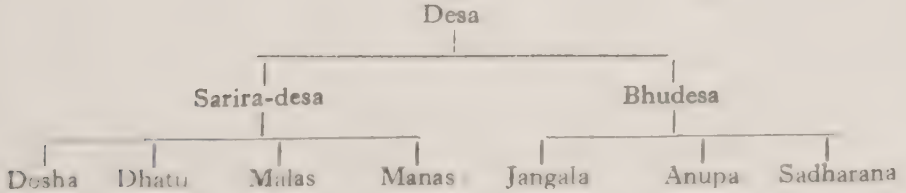
Anūpadesa, on the other hand, is the reverse of *jāngaladesa* i.e., it can be characterised as a moist and water-logged place, densely vegitated, having large hills and mountains in it. It is considered to be responsible for the incidence of a large number of *kaphaja type* of diseases.

आनूपो विपरीतो.....॥

(Ibid)

Sādhārana or *samadesa* can be described as an environment possessing moderate vegetation, hills and mountains, sufficient rainfall and watersupply. This kind of place can be characterised as a salubrious or congenial healthy environment in which, the *doshās*, *dhātūs* and *malās* are generally maintained in a state of equilibrium.

Dehadesa i.e., the body soil or internal environment is constituted by the *dhātūs* or the tissues i.e., structure; *doshās* or functions; *malās* or waste products and the *manas*. The latter is characterised by the *trigunās* viz., *satva*, *rajas* and *tamas*. In the words of Dr. Alexis Carrel, the internal environment is "interwoven in the organic, humoural and mental factors which form an indivisible whole."



Time factor in relation to the therapeutic effects of medicaments

The production of optimum effects by the administration of medicaments depends on the correct assessment of the time factor with reference to their application and stages and aspects of diseases. This 'time is classified under two heads viz., *kshanādi* or moment etc., i.e., moment, *kāshta*, *kala*, *nādi*, *muhūrtha*, *yāma*, *ahas*, *rātri*, *paksha*, *māsa*, *ayana*, *varsha*, etc.[1]

क्षणादिर्व्याध्यवस्था च कालो भेषजयोगकृत् ॥

Two kinds of medicaments—sodhana and samanaushadhās

Medicaments have been classified under two general heads viz., (a) *sodhanaushadhās* and (b) *samanaushadhās*.

शोधनं शमनं चेति समासादौषधं द्विधा ।

Main lines of Samana and Sodhana therapies in somatic disturbances

The main lines of *sodhana* or radical therapy of *somatic* disturbances caused by *vāta*, *pitta* and *kapha* are the administration of *vasti* or medicated enemata (*nirūha* i.e., *āstāpana* or *kashāyavasti* and *anuvasāna* or *snehavasti*), *vireka* or purgation, and *vamana* or emitics respectively. The *samana* or palliative therapeutics for these *doshas* consists mainly of the administration of *thaila* or medicated oils for *vāta*, *ghrita* or ghee for *pitta* and *madhu* or honey for *kapha*.

शरीरजानां दोषाणां क्रमेण परमौषधम् ॥
बस्तिर्विरेको वमनं तथा तैलं घृतं मधु ।

1. Refer to the Fundamental Principles of Ayurveda—Outlines of the Nyaya Vaiseshika System of Natural Philosophy, Part I: pp. 39-40.

Psychotherapy

The main therapy for psychic or *mānasika rogās* i.e., the upheavals of *rajas* and *tamas*, consist of the possession and or the inculcation of *dhi* or intelligence, *dhairya* or courage and *ātma-vignāna* or the knowledge of the '*Science of Self.*'

धीधैर्यात्मादिविज्ञानं मनोदोषौषधं परम् ॥

Four limbs of Medicine

The successful practice of medicine needs four limbs to support it. They are :

i. The *bhishak* or the physician ;
ii. The *dravya* or medicament ;
iii. The *upasthāta* (*paricharaka*) or nurse, and
iv. The *rogi* or patient.

भिषक् द्रव्याण्युपस्थाता रोगी पादचतुष्टयम् ।
चिकित्सितस्य निर्दिष्टं,..... ॥

The four limbs mentioned above should each possess four qualifications ; viz·,

.....प्रत्येकं तच्चतुर्गुणम् ॥

i. *The bhishak or physician* should be an expert in his profession. He should have acquired his knowledge of the Science of Medicine under reputed authorities. He should himself possess practical knowledge of the Art of Medicine and be clean in mind and body.

दक्षस्तीर्थात्तशास्त्रार्थो दृष्टकर्मा शुचिर्भिषक् ।

ii. *The aushadha or medicament* should have been prepared in many forms and by different processes. They

should possess many valuable properties. The constituents (herbs) with which they are manufactured should have been grown in proper soil, fully matured and gathered in proper seasons, having regard to the principles and rules prescribed for their collection, curing and storage, and prepared suitably as specifics for each disease.

बहुकल्पं बहुगुणं सम्पन्नं योग्यमौषधम् ॥

iii. *The upasthāta* (*parichāraka*) or nurse should be a person of sympathetic and kindly disposition, clean in mind and body, capable and resourceful in his (or her) profession, and endowed with intelligence and talent.

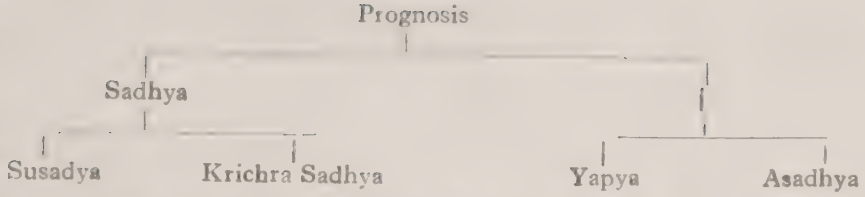
अनुरक्तः शुचिर्दक्षो बुद्धिमान् परिचारकः ।

(iv) The *rogi* or the patient should be possessed of wealth, obedient to the physician, strong in memory and courageous.

आढ्यो रोगी भिषग्वश्यो ज्ञापकः सत्त्ववानपि ॥

Prognosis of Diseases

Ayurveda has classified the prognosis of diseases under two categories viz., (a) *sādhya* or curables and (b) *asādhya* or incurables. These two are again classified under two categories each viz., (i) *susādhya* or easily curables; (ii) *krichra sādhya* or those which are curable with difficulty, and (iii) *yāpya* or incurables in which the patients suffering from incurable diseases can still be made to live as long and as comfortably as possible with proper dieting, medications and other appropriate measures, and (iv) *asādhya* or fatal types.



साध्योऽसाध्य इति व्याधिर्द्विधा, सौ तु पुनर्द्विधा ।
सुसाध्यः कृच्छ्रसाध्यश्च, याप्यो यश्चानुपक्रमः ॥

The sukhasādhya or easily curable diseases : Diseases occuring in a person who possesses a constitution which is capable of withstanding the rigour of therapeutic measures and the action of powerful drugs are easily curable. Likewise, diseases occuring in males and of them, the youths, are easily amenable to treatment as compared to those in females; diseases occuring in persons who are *jitendriyās* i.e., those who have achieved mastery over their senses are easily curable. Even so, diseases which do not occur in vital organs; those which arise on account of light causes and exhibit mild prodromal symptoms, symptoms etc., and which are uncomplicated, are also easily curable. In the same manner, where the *dhātūs* of the body, the *desa* or place of residence of the patient, the *rutu* or season of the incidence of the disease and the *prakriti* of the patient exhibit traits opposite of those of the disease, in such cases, the disease is easily curable.

This concept has been illustrated as follows :

(a) When diseases which arise on account of the disturbance of *pitta dosha* occur in a patient living in *anūpa desa* involve *medas*, *majja* and other *dhātūs* then, due to the influence of *kāla* and *desa* (both *deha* and *bhudesas*), such diseases are *sukhasādhya* or easily curable ;

(b) Cases in which *raktadhātu*, the *virya* of which is *ushna*, is provoked by *kapha* the *virya* of which is sita, are easily curable.

(c) The occurance of diseases which are essentially *kaphaja* in nature in a person possessing *pittaprkriti* are easily curable.

In addition to the above, diseases which arise due to the disturbance of any one only of the three *doshās* and involves the channel of spread of the particular *dosha*, as also cases in which the planetary disposition is favourable and where all the four limbs of medicine are available, are also easily curable. Likewise, diseases treated in their early stages have good prognosis.

सर्वौषधक्षमे देहे यूनः पुंसो जितात्मनः ।
अमर्मगोऽल्पहेत्वग्ररूपांऽनुपद्रवः ॥
अतुल्यदूष्यदेशर्तुप्रकृतिः पादसंपदि ।
ग्रहेष्वनुगुणेष्वेकदोषमार्गो नवः सुखः ॥

Krichra sādhya or diseases which are curable with difficulty : Diseases which necessitate the employment of surgical measures and also those which exhibit a few of the several characteristics described for easily curable diseases, are curable with difficulty.

शस्त्रादिसाधनः कृच्छ्रः सङ्करे च ततो गदः ।

Yāpya or manageable though incurable diseases : Under this category are included cases of patients whose diseases lack traits which characterise those of the curables, but who still have a residue or span of life to live, and who can be made to live as long and as comfortably as possible with the help of appropriate dietic regimen and therapeutic measures.

शेषत्वादायुषो याप्यः पथ्याभ्यासाद्विपर्यये ॥

Asādhya or fatal types: Diseases which have become complicated in every way and taken a serious turn, and which are not amenable to any treatment, are of fatal prognosis. The occurance of *autsukya* or sudden anxiety, uneasiness, ardent desire and the like, *moha* or pronounced delusion of mind and restlessness, as well as the loss of the functions of the special senses, indicate fatal prognost.

अनुपक्रम एव स्यात्स्थितोऽत्यन्तविपर्यये ।
औत्सुक्यमोहारतिकृद् दृष्टरिष्टोऽक्षनाशनः ॥

THE TYPE OF PATIENTS TO BE AVOIDED

The following types of persons are not fit for treatment and are, therefore, to be avoided :

One who has been discarded by and is enimical to physicians and kings (State) ; an enemy of the physician who treats him ; the person who lacks the means and resources required for his treatment ; one who is fully preoccupied with and worried by too much of work and commitments ; the disobedient person ; one whose span of life is nearing an end ; a turbulent person ; one who is immersed in grief ; a coward or one who lacks courage ; the ungrateful person, and a person who has pretensions to knowledge of medical science.

व्यजेदार्तं भिषग्भूपैर्द्विष्टं तेषां द्विषं द्विषम् ।
हीनोपकरणं व्यग्रमविधेय गतायुषम् ॥
चण्डं शोकातुरं भीरु कृतघ्नं वैद्यमानिनम् ।

Section II

DRAVYĀDI VIGNĀNA

The chapter entitled *Dravyādi Vignana* deals with the knowledge[1] and science[2] of *dravya* or substance[3] or Matter. The term '*ādi*' cannotes the properties (qualities) of substances, such as *rasa*, *guna*, *virya*, *vipāka* and *prabhāva.*

In its widest sense, the term *dravya* is the first in the category of the *Bhāva padārtās* of the *Nyāya Vaiseshikā system.* In this sense, they (the *dravyās*) are the substrate[4] of *guna*,[5] *karma*,[6] and *kārana*[7] ,*samavāya*)[8] .

यत्राश्रिताः कर्मगुणाः कारणं समवायियत् ।
तत्द्रव्यं..... .....॥

(Charaka, Sutra 1; 51)

The category *dravya* comprehends nine substances of which *prithvi*, *ap*, *tejas*, *vāyu* and *manas*,

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1. "The accumulation of facts collected in books and in the minds of men constitute knowledge. A mass of facts, however reliable is not science". (inorganic & General Chemistry by Sherwood Taylor, Ed. 1930 ; p. 1]

2. "It is only when facts are linked with ideas, theories and natural laws in such a way that they can be looked at as a whole and can take their place in the vast pattern of nature, that science is formed." [Ibid, p. 2]

3. "Substances consist of a single kind of material with properties (i. e., qualities) sufficiently constant and well marked to distinguish them from other kinds of material". [Ibid p. 19]

4. Charaka ; 1; 51.

5. 'Gunaha' means here the primary qualities of elementary substances.

6. "Karma" is 'action'

7. 'Karana' is 'cause'

8, Samavayi' is 'inseparable coinherence'.

have been described as elementary [1] and atomic[2] (*anu*) in structure. *Ākāsa kāla, dik* and *ātma* are stated to be all-pervasive and non-atomic i. e., *vibhu* or continuum.

In this section, the theories of the *Nyāya Vaiseshika* system have been extended to apply to various kinds of compound substances i.e., *āhāra* and *aushadha drāvyās*. A proper and intelligent grasp and appreciation of *Dravyādi Vignāna* will largely depend upon a grounding in the *anuvāda* or atomic theory of the *Nyāya Vaiseshika* system, as will become evident from the opening *sūta* of the chapter viz.,

द्रव्यमेव रसादीनां श्रेष्ठं, ते हि तदाश्रयाः ।

i. e. *dravya* i. e., substance or the Matter, is of greater importance than its several secondary qualities, such as *rāsa, guna, virya vipāka* and *prabhāva*,[3] for, the latter depend (or arise) exclusively out of the composition and properties of the former.

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1. "An element is a distinct species of matter which has not yet been shown to be composed of two or more different kinds of matter." [Inorganic Chemistry by Sherwood Taylor, Ed. 1939, p. 20]

2. " The atom is the smallest particle of any particular element which can take part in a chemical change " [Ibid. p. 47]

' A paramanu, according to the Vaiseshika school of Natural Philosophy, is the ultimate unit of Matter. (p. 3: The outlines of the Nyaya Vaiseshika System of Natural Philosophy, by the author)

3. By the term 'secondary qualities' is meant the qualities exhibited by compound substances which were not possessed by the constituent elements composing them. These qualities are stated to be transient, as they exist so long as the compound as such exists, and disappear when they are decomposed or disintegrated, when their constituent elements become separated and are restored to their natural states of existence. The example of water

[*Foot note coutinued in the page 82*]

The significance of this *sūtra* will be seen from the next *sūtra* which says :

पञ्चभूतात्मकं तत्तु..... ..... ।

i.e., "because they (the substances) are composed of the five *bhūtās*."

The elementary substances (*panchabhūtās*) with which every compound substance is constituted are the *kārana* or the cause. They are not the effects or *kārya* of any other antecedent cause or causes, whereas, *rasa*, *guna*, *virya*, *vipāka* and *prabhāva* of substances which arise out of the combination and permutation of the five elementary substances in various modes and patterns, are really the effects or *kāryās*. It is for this reason that the *panchabhūtās* are known as *kārana dravyās*.[1] The diversity of substances which arise out of the various modes of combination and permutation of these elementary substances are described as *kārya dravyās*.

From the point of view referred to above, the various properties (qualities) ascribed to compound substances, are stated to be held in a potential state in the

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will illustrate this concept adequately. The physical and chemical properties characteristic of water are not shared by its two constituent elements viz, oxygen and hydrogen. The physical and chemical characteristics of water can, in a fundamental sense, be stated to be secondary and transient in nature, whereas, those of its constituent elements O_2 and H are primary and permanently associated with these elements. Similar is the case with the gunas, rasa, vipaka, virya and prabhava of compound substances. 'Primary qualities' can be described as those which characterise elemental substances and which are not seperable from them. This concept can again be illustrated with the example of oxygen and hydrogen, Not unless these two elements are broken down or disintegrated can the primary qualities which characterise them be destroyed.

1. This view is held by the Nyaya Vaiseshika system.

elementary substances that compose them. These properties become actualised in the *effect* or *kārya*, which are described in terms of *rasa*, *guna*, *virya*, *vipāka* and *prabhāva*. This concept is based on the principle that " the properties which exist in the causative factors are present in the resultant factors. "

कारणगुणपूर्वकः कार्यगुणो दृश्यते ।

Stated in terms of recent trends in New Physics, "the initial state of a system wholly determines its subsequent states. " [1]

According to this principle, each one of the five elementary substances is stated to possess some special or specific properties (qualities). [2] The various compound substances that arise out of such combinations of the five elementary substances are stated to develop and manifest properties held potentially in the latter. In other words, ' the effect is potential in the cause. ' In principle, therefore, there is no difference between the cause or *kārana* and effect or *kārya*." Because of the identity of the effect and the cause, the term *bhūta* is understood and spoken of as *bhoutika* ".

कार्यकारणयोरभेदोपचारात् भूतशब्देन भौतिकमुच्यते ।

(Ayurveda Rasayana on Ashtanga Hridaya)

1. The Fundamental Principles of Ayurveda-Part II, " Outlines of the Samkhya Patanjala System," by the author, p. 82.

2. By ' special properties ' is meant the primary qualities of elementary substances, viz.,

सार्था गुर्वादयो बुद्धिः प्रयत्नान्ताः परादयः ।
गुणाः प्रोक्ताः ..... ।

(Charaka ; Sutra: 1; 48)

How the multiplicity of substances in their infinite diversity, exhibiting varying and different physical properties (characteristics and qualities) arise out of the fivefold elementary substances, is the next point to be considered.

The basis or support for the formation or composition of substances —molecules[1] of substances —is *prithvi*.

.....क्ष्मामधिष्ठाय जायते।

i.e., "They (the *dravyās*) arise on the substrate of *prithvi*." In this view, all the five *bhūtās* are necessary for the formation, growth and development of compound substances. If substances are to be formed or composed, they need a basis or ground-substance (matrix) for their support i.e., *ādhāra* (आ ार. In the context of the atomic theory of the *Nyāya Vaiseshika* and *Sāmkhya Yoga* systems, *prithvi* takes the place of mass or nucleus, round which (or depending on which) the atoms of other *bhūtās* align themselves to form different kinds of compound substances.[2]

Āpa, in this scheme of the formation of compound substances becomes the cause for the other elements viz., *agni*, *pavana* and *nabhas* to combine or cohere.

अम्बुयोन्यग्निपवननभसां समवायतः।
तन्निवृत्तिविशेषश्च..... ... ॥

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1. 'Pitharas' correspond to the modern idea of molecules. They are stated to be composed of more than one anu or atom, such as Dwayanukas, Trayanukas, Chaturanukas etc.

2 Refer to the diagramatic representation of the constitution of the 'Bhuta Paramanus' the Fundamental Principles of Ayurveda, Part II, "Outlines of the Samkhya Patanjala System" by the author pp. 80-81.)

In other words, the *bhūta, āpa* is the cause of or the *yoni* or medium through which the other elements cohere i.e., *samavāya*, to form compound substances.

Due to the inevitable combination of the five *bhūtās* (in varying collocations), the substances thus formed, assume varying forms and exhibit different characteristics, according to the preponderance of the one or the other of the *bhūtās* over others in the collocation.

....व्यपदेशस्तु भूयसा ।

It is for this reason that each *dravya* or substance is stated to possess and exhibit a multiplicity of *rasās* (or tastes). It is also for the same reason that a multiplicity of diseases due to the vitiation of the *doshās* are also seen to arise.

तस्मान्नैकरसं द्रव्यं भूतसङ्घातसम्भवात् ।
नैकदोषस्ततो रोगास्तत्र .... ।

This concept has been explained as follows:

"By the use or the consumption of substances which are composed of the five *bhūtās* in varying proportions and in different collocations, *vāta*, *pitta* and *kapha* of the body which are built up by the same kind of substances (tend to) become vitiated, leading to the manifestation of different kinds of *vikārās* (or upsets and abnormalities.)"[1]

1. According to Charaka, "the body is the product of food; diseases arise on account of [faults in] food; the distinction between happiness and sorrow result from the difference between the wholesome and unwholesome diet."

आहारसंभवं वस्तु रोगाश्चाहारसंभवाः ।
हिताहितविशेषाच्च विशेषः सुखदुःखयोः ॥

(Charaka; Sutra; 28; 45)

[*Foot note continued in the page* 86]

Rasa or taste sensibility

An important quality manifested by substances (compound substances) is that which makes a gustatory appeal i.e., *rasa*.

Of the several *rasās* inherent in *dravyās* (or substances), the one which is cognized first (by impact with the tongue) is spoken of as the primary *rasa* of the *dravya*.[1] *Rasās* which are less apparent or cognizable, but which are sensed subsequently, are known as *anurasās* or secondary or subsidiary *rasās*.[2] *Anurasās* are also known as *uparasās*.

व्यक्तो रसः स्मृतः, अव्यक्तोऽनुरसः, किञ्चिदन्ते व्यक्तोऽपि चेष्यते ॥
(Ibid)

"It is the very elements whose wholesome combination gives rise to the well being of man. The unwholesome combination of the elements gives rise to various kinds of diseases."

येषामेव हि भावानां संपत् संजनयेन्नरम् ।
तेषामेव विपद्व्याधीन्विविधान्समुदीरयेत् ॥ (Ibid 25; 29)

"The body is the result of nutrition administered in fourfold manner viz. eaten, drunk, licked up and masticated. Likewise, the diseases which afflict the human body also arise as the result of food that is eaten, drunk, licked and masticated. It is the distinction between the use of wholesome and the unwholesome diet that is responsible for the distinction between health and disease."

एवमिदं शरीरमशितपीतलीढखादितप्रभवम् । अशितपीतलीढखादितप्रभवाश्चास्मिन् शरीरे व्याधयो भवन्ति । हिताहितोपयोगविशेषास्त्वत्र शुभाशुभविशेषकरा भवन्ति ॥ (Charaka; Sutra 28; 5)

1. व्यक्तः शुष्कस्य चादौ च रसो द्रव्यस्य लक्ष्यते ।
(Charaka; Sutra 26; 2)

"The taste which becomes patent on the contact of a dry substance with the tongue is stated to be its taste."

2. विपर्ययेणानुरसो नास्ति हि सप्तमः ॥ (Ibid)

"What is otherwise apprehended is its latent or aftertaste." [Ibid[

The nearest but not satisfactory equivalents of the terms *rasa* and *anurasa* (*uparasa*) are primary and secondary (or subsidiary) tastes, respectively. This translation of *rasa* as taste does not, however, reflect the full significance and implications of these terms. The taste-perception and taste sensibility are complex bio-physical and psychological events. The following, among others, contribute to the *rasa* or taste perception or sensibility :—

1. The nature and physico-chemical constitution of substances tasted ;

2. The structure and functions of the chemo-receptors in the tongue and mouth ;

3. The areas in the cerebrum to which the sensory impulses are carried and where they are compounded, oriented and projected back to the tongue ;

4. The various reflexes mediated through the sympathetic and para-sympathetic pathways to the near and distant organs, such as the salivary, gastric and intestinal glands, liver, pancreas, endocrine glands and the rest, and,

5. The mind.

It is necessary at this stage to digress from the main subject and take into account the nature and function of the receptors concerned with the sense of taste. In the language of modern physiology, the following receptors are concerned with the sense of taste :

(i) The exteroceptors which are in the nature of chemo–receptors i.e., those stimulated by forces from outside the body, viz·, the receptors of smell and taste, which are excited by suitable concentration of substances in solution ;

(ii) Proprioceptors stimulated by the activities which occur within the body itself ;

(iii) Interoceptors stimulated by substances or conditions within the digestive cavities.[1]

In so far as taste-perception or taste-sensibility is concerned, the taste-receptors (chemo-receptors) are the so-called taste–buds. These are chiefly located in the mammals in the tongue, but occur scantily in other parts of the buccal cavity. It is estimated that there are about 9000 such taste–buds in the tongue and in each taste-bud, there are a number of elongated cells, each of which ends in minute hairlike process, known as gustatory–pores.

Primary qualities of taste

From the point of view of modern physiology, four primary qualities or modalities of tastes have been recognized in man. They are, sweet, sour, salty and bitter. Only four kinds of taste sensations and four only can be elicited in him. These are differently located. In other words, each of the primary sensations of taste is dependent upon the excitation of a special kind of receptor, as has been shown by the differences

1. Sherrington's clasaification, General Physiology by Mitchel· pp: 177-178 [Ed. 1939].

in the areas of the tongue that are receptive to the different tastes. The sweet taste is roused especially on the tip of the tongue, though present to some extent in other areas. The receptors for the bitter taste are numerous at the root of the tongue, though present to some extent in other areas. Sour and salty taste receptors tend to be concentrated along the sides of the tongue.

The taste-buds occur for the most part in the walls of the papillae and testing each one by single drops of sapid solutions applied with the tip of a fine brush, the receptors of each papillae can be detected. By this process, some of them have been shown to have receptors for sweet or sour or salty or bitter tastes alone; others have for two of the so called primary tastes; some for three different kinds and a few papillae respond to all the four.

However, no histological evidence or any other information is available to show differences in the structure and composition of the four kinds of taste-receptors that are assumed to occur.

Inter-relationship between taste and smell

Taste as well as smell are not so complex as those of vision and hearing. They make us become aware of a much simpler world. They are much more localised or circumscribed. The stimuli affecting vision and hearing may be at a distance from the receptive sense organs. But in the case of taste and smell, the stimuli must be at a close proximity or in actual contact with the related receptive sense organs. As between the sense of taste and the sense of smell, the latter can be considered as a distance instead of a contact

receptor, which is in a way true. But, the particles of the odourous substances which stimulate the olfactory cells must pass in respiration into the nostrils and be in actual contact with the sensitive surface before the smell-sensation is experienced. In other words, the radius of the action of the smell receptors is much more limited as compared to visual or auditory receptors.

Taste and smell are very closely associated with each other than is generally known. But for the smell-sensibility, most of our daily food may prove to be almost quite tasteless. In other words, the many varieties of tastes commonly experienced by us are compounded in our consciousness i.e., mind, out of both taste and smell sensations. For example, some substances which appear to possess a characteristic taste, either prove to be tasteless or are very different in taste if held in the mouth while the nose is plugged. An example of this phenomenon can be cited. It has been shown experimentally that onions and apples cannot be distinguished under the circumstances by taste alone, even though their differences in texture can be detected by the sense of touch upon the tongue. The sense of taste, as compared to that of smell, is less delicate. For example, in the case of alcohol which is both spaid and odorous, larger quantities are required to produce taste than to detect smell.

Mechanism

It is considered that direct stimulation takes place in the gustatory pores resulting in the vibration of the hair-like protoplasmic processes which are converted into impulses in the taste-buds and passed on to the nerves, and thence to the brain.

The Taste nerves

The innervation of taste-buds are more complex than those of smell, even though according to the current view, there are only four main tastes. Three of the cranial nerves are concerned in this innervation viz., the glossopharyngeal nerve (9th cranial), lingual branch of the trigeminal nerve (5th cranial) and the chorda tympani of the facial nerve (7th cranial). In addition, a few twigs of the vagus i.e., the 10th cranial nerve supplies the pharyngeal surface of the tongue. The 12th cranial or hypoglossal, is the motor nerve of the tongue. All these nerves are concerned in the transmission of taste messages to the brain and they inter-communicate through fine branches near their roots.

The stimulation of taste-nerves by the taste-buds, to which a reference was made above, is stated to arise out of the vibrations set up by the molecules and ions in the solution of substances tasted, very much in the manner of the mechanism of olfaction, which has recently been shown to be an echo-resonance phenomenon – a new theory which relates the sense of smelling to that of light through waves comparable to those of light and radio, but carrying smells, which are the essence of this theory[1]. The taste-impulses are collected, differentiated and passed on through the related cranial nerves. Moncrieff observes: „Taste is primarily stimulated by a chemical reaction seems probable and that ionization plays a part is certain. It is equally certain that it is

1. Beck and Miles, Science 106; 511, 1947.

not entirely chemical, or stereo-isomers could hardly have different tastes, as they do have in many cases. Possibly molecular vibration of Dyson's correlation of the Raman effect with odour is the initial stimulus, but that it is followed by chemical action on absorption or chemical orientation on the tongue is most likely."[1]

It is considered possible that the molecular and ionic vibrations of substances possessing different tastes set up frequencies and wave-lengths, specific to each taste-bud, may result in the stimulation of the gustatory hairs of the related taste-buds.

Some tastes, for example the metallic taste, are stated to be complex and not simple. This taste is said to arise on account of a mixture of sweet and salt tastes.

Certain areas of the tongue—the front and back—give raise to only one quality of sensation. It is, therefore, considered possible that the same substance may give rise to different tastes in different regions of the tongue. For example, the sulphate of magnesium tastes bitter at the root of the tongue, but it may be experienced as sweet at the tip.

Quantitative Determination

The method of the determination of the threshold of the intensity of taste is very much like that of vision, pressure or hearing. This varies widely for different individuals and also for the four gustatory qualities. Bitter, sweet, salt and sour, have each their own intensity threshold.

1. Monocrieff, Chemical Senses, p. 171. 1951 Edition

The method of the determination of the threshold of tastes can be illustrated with reference to saltish taste. Weigh out 10 grammes of common salt and dissolve it in a litre of water. Every cubic centimetre of this solution will contain ·01 gm of salt. Measure out 10 c. c. of this solution and make it up to 100 c. c. Each cubic centimetre of this solution will contain .001 gm of salt. Following this method, salt solutions of varying strengths can be made up, as for example, concentrations of ·001, ·002, ·003, ·01, ·03 etc., gm of salt per c.c. Determine that solution with which the salt taste can first be detected, using a simple variation of the method of limits. By this way, we can determine the threshold with some degree of accuracy. If for example, it is found that the threshold of salt taste lies between ·0001 and ·001 i e., if the subject can detect no salt in the former solution and make it out in the latter, because the correct value is between ·0004 and ·0005, we can make up solutions of strengths ·0002, ·0003, ·0004 and proceed as before.

TABLE SHOWING AVERAGE THRESHOLDS OF DIFFERENT TASTES [1]

Receptor	Substance used	Minimal concentration giving difference taste	Part of tongue tested
Salty (lavana)	NaCl	0·04 molar	Tip and sides
Sweet (madhura)	Sucrose	0.02 molar	Tip
Sour (amla)	HCl	0.002 molar	Sides
Bitter (tikta)	Quinine-HCl	0.00004 molar	Root

1. General Physiology by Mitchell (3rd edition p. 183.)

It will be seen from the foregoing, that the taste-perception is a complex of a number of events of which the atomic and molecular constitution of substances tasted are important. According to the *Nyāya Vaiseshika* school of natural philosophy too, *pilūs* (or atoms), *pitharās* (or molecules) which compose substances; the *pāka* in the mouth of the substances tasted or chemical reactions involving the breakdown and dissociation of substances under the influence of *vijātiya tejas*; the *parispanda* (or vibrations) of *pitharās* or molecules and *pilūs* or atoms, are factors which are mainly concerned in the perception of specific kinds of tastes.

Panchabhautic constitution of rasās

Resuming the consideration of *rasās* from where we digressed, it is seen that according to *Ayurveda*, each one of the *shadrasās* is constituted by the combination of two of the five *bhūtās*.[1] Says *Vāgbhata :*

क्ष्माम्भोग्निक्ष्माम्बुतेजःखवाय्वग्न्यनिलगोनिलैः ।
द्व्योल्लवणैः क्रमाद्भूतैर्मधुरादिरसोद्भवः ॥

1. Says Charaka : "Of the six rasas, sweetness arises on account of the preponderance in the substance of elements ap and prithvi ; acidity or sourness are due to prithvi and tejas ; saltishness is due to ap and agni ; acridity is due to vayu and agni ; bitterness is due to vayu and akasa, and astringency is due to vayu and prithvi."

तेषां षण्णां रसानां सोमगुणातिरेकान्मधुरो रसः, पृथिव्यग्निभूयिष्ठत्वादम्लः, सलिलाग्निभूयिष्ठत्वाल्लवणः, वाय्वग्निभूयिष्ठत्वात् कटुकः, वाय्वाकाशातिरिक्तत्वात्तिक्तः, पवनपृथिवीव्यतिरेकात् कषाय इति ।

"In this manner", continues Charaka, "due to the preponderence or otherwise of the five elemental substances, the six kinds of rasas or tastes arise in the same way as the diversity of colour and form of animal and vegetable substances occur."

[*Foot note continued in page 95*]

In other words, the correlation of the *bhūtās* to *rasās* are as shown below :

Prithvi cum ap Madhura or sweetness ;
Agni cum prithvi Amla or sour ;
Ap cum tejas=Lavana or saltish ;
Ākāsa cum vāyu= Tikta or bitterness;
Tejas cum vāyu=Katu or acridity;
Prithvi cum vāyu=Kashāya or astringency.

Gunās and Rasās

The (primary physical) qualities, such as *guru* (gravitation) etcetra,[1] are coinherent in the *bhūtās* i.e., *prithvi, ap, tejas, vāyu* and *ākāsa* on which the constitution of *rasās* depend. In consequence, there is a correlation between *rasās* and *gunās*. It has, therefore, been stated that the former are intimately correlated to the latter. The (primary physical) qualities of the *bhūtās* (or the five fold elemental substances) such as *guru* and the rest are stated to be coinherent or *samavāyi* in the *bhūtās* themselves which are also the substrate of *rasās*. As the occurance of *rasās* depend on the nature and mode of the collocations of *gunās* (primary physical qualities of the *bhūtās*) in (compound) substances, it has

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एवमेषां रसानां षट्त्वमुपपन्नं न्यूनातिरिक्तविशेषान्महाभूतानां नानावर्णाकृति विशेषाः ।

Relying on this statement of Charaka, Prof. B. N. Seal observes in his "Positive Sciences of the Ancient Hindus" that: "Colour phenomenon, according to Charaka school, is intimately connected with the formation of molecular qualities in chemical compounds – organic and inorganic – due to chemical combinations. Both colours and taste of molecules of chemical compounds arise out of the collocation in unequal proportion and unstable equalibrium of the various forces latent in the paramanus themselves."

1. The term 'etcetra' comprehends the remaining seven primary physical qualities of the elementary substances.

been stated that the *gnnās* are intimately related to *rasās*. In other words, the characteristic tastes of (compound) substances are correlated to the (primary physical) qualities of the *bhūtās* which collocate in their formation.

गुर्वादयो गुणा द्रव्ये पृथिव्यादौ रसाश्रये ॥
रसेषु व्यापदिश्यन्ते साहचर्योपचारतः ।

In this connection, the allusion made by *Charaka* to the behaviour of substances possessing different *rasās* in terms of the motions of the former is worth noting. He says: "Of them, *rasās* whose constitution is essentially *agni* and *vāyu* exhibit a tendency to upward movement on account of their natural lightness and the property of *vāyu* to soar, and *agni* to shoot upwards."

तत्राग्निमारुतात्मकारसाः प्रायेणोर्ध्वभाजः, लाघवादुत्प्लवनत्वाच्च वायोरूर्ध्वज्वलनत्वाच्च वह्नेः । [Charaka ; Sutra 26; 41 (1)]

"On the contrary, *rasās* which are composed of *ap* and *prithvi*, the nature of the later being heaviness and the former fluidity, generally exhibit the tendency for downward movement."

सलिलपृथिव्यात्मकास्तु प्रायेणाधोभाजः, पृथिव्या गुरुत्वान्निम्नगत्वाच्चोदकस्य ;
[Ibid 41 (2)]

"The *rasās* of mixed types tend to exhibit tendencies of both upward and downward movements."

व्यामिश्रात्मकाः पुनरुभयतोभाजः । [Ibid 41]

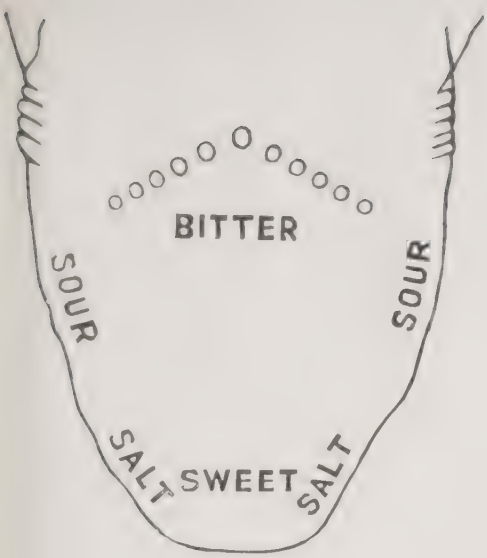
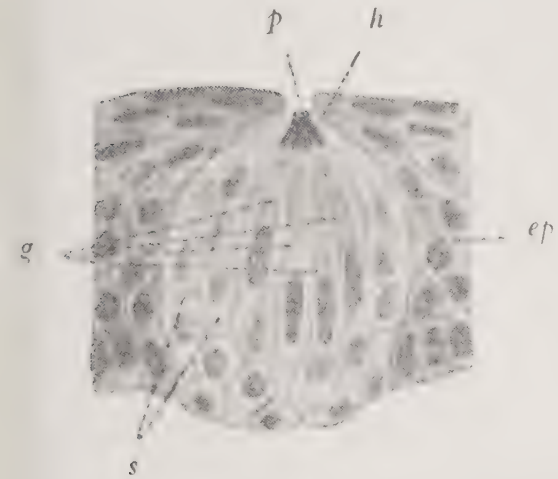


DIAGRAM OF THE TONGUE SHOWING THE DISTRIBUTION OF THE AREAS OF THE FOUR TASTES.



A TASTE-BUD WITHIN THE STARTIFIED EPITHELIUM OF THE TONGUE.

g, gustatory cells ; *s*, sustentacular cells ; *ep*, epithelium, *p*, gustatory pore, *h*, hairlets.

VARIOUS CELLS FROM TASTE-BUD OF RABBIT.

a. Four gustatory cells from central part ;

b. One sustentacular cell, and two gustatory cells, in connexion ;

c. Three sustentacular cells.

(*After Schafer's Essentialsof Histology*)

Katu and kashāya rasās

Before proceeding to discuss the physiological actions of *rasās*, it is necessary to consider the possible reasons for the inclusion of *katu* (acrid) and *kashāya* (astringency) among and the exclusion of *kshāra* from the *shadrasās*. The former two *rasās* have not been treated as tastes by modern physiology, largely because of the absence in the tongue of taste-buds which these two tastes can stimulate. Even so, the sensations they evoke, which we experience as acridity and astringency, have been shown to be really the sensations of irritation due to the stimulation of the heat and pain receptors in the tongue in the former case, and the sensation created due to the shrinking or contraction of the mucosa of the entire tongue, palate and pharynx, in the case of the latter. Nonetheless, the inclusion of these two tastes among the *shadrasās* by *Āyurveda* appears to be justified from the fact that : (i) within normal and bearable limits, substances tasting acrid and astringency evoke the flow of saliva in the mouth, and the gastric juice in the stomach, as well as a pleasurable sensation of relish ; and (ii) as compared to the countries in the west where substances possessing acrid and astringent tastes are not usually included in or added to foods, the Indian diet, especially in the south, will be considered insipid and unappetising in the absence of these two tastes – in particular, the acrid. It is in the ordinary experience of south Indians that the very mention of *kāra chatni* and pickles is sufficient to result in the watering of the month and the feeling of relish to eat. The absence of specific areas and taste-buds in the

tongue for these two tastes has obviously been compensated by the action of the higher cortical centers which are stimulated by the sight and thought of foods as are pleasantly acrid and astringent in taste. In a word, these two tastes, are conditioned-reflexes in Indians, hence perhaps the reason why they have been added to the four main tastes, viz., sweet, acid, salty and bitter.

As regards *kshāra* or alkaline taste, *Punarvasu Atreya* has been quoted by *Charaka* in his *Samhita* to have ruled out its inclusion among the *shadrasās*, on the following grounds: "Alkali is so named because it alkalises. It is not a taste but a substance derived from substances possessing various tastes. It possesses various tastes,[1] the more predominant of which are the pungent and the saltish. In addition, it has attributes which can be perceived by more than one sense. It is besides, a manufactured product."

क्षारणात् क्षारः, नासौ रसः, द्रव्यं तदनेकरसमुत्पन्नमनेकरसं कटुकलवणभूयिष्ठ-मनेकेन्द्रियार्थसमन्वितं करणाभिनिवृत्तम् ।

[Charaka, Sutra 26; 9 (3)]

The Physiological Actions of Rasās

Madhura or sweet taste: "The sweet taste stimulates the secretion of a pasty fluid which besmears the mouth; it creates a pleasurable sensation (feeling) in the body ;

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1 "It has been suggested" observes Moncrieff "that alkaline taste is a complex of other tastes and touch". (Chemical Senses, Moncrieff, p. 149; 1951 Edn.)

imparts clearness to the senses (exteroceptors specially), and it is liked by ants and such other creatures." [1]

तेषां विद्याद्रसं स्वादुं यो वक्त्रमनुलिम्पति ।
आस्वाद्यमानो देहस्य ह्लादनोऽजप्रसादनः ।
प्रियः पिपीलिकादीनाम् ..... ।

Charaka describes the properties and actions of sweet taste as follows :

"Sweet taste being *sātmya* or is attuned to the tissues of the body increases the *rasadhātu* (the tissue fluid and lymph), *rakta* (blood), *māmsa* (muscle tissue), *medas* (adipose tissue), *asti* (bone tissue), *majja* (bone marrow), *sukra* (the reproductive elements)[2] and *ojas*;[3] it promotes longevity, cleanses the senses and keeps them clear, imparts vigour and promotes the

1. Charaka notes " sweet taste is recognised in the mouth by its effects viz., viscosity, satisfaction, pleasure and softness. Spreading all over the mouth, it produces a feeling as though the mouth is besmeared with sweetness"

स्नेहनप्रीणनाह्लादमार्दवैरुपलभ्यते ।
मुखस्थौ मधुरश्चास्यं व्याप्नुवंल्लिम्पतीव च ॥
(Charaka, Sutra 26; 74)

2. The 'sukra dhatu' of Ayurveda, not only represents the seminal fluid but also the intetnal secretion of the testes which determines and regulates the male sexual character.

3. According to Ayurveda, ' ojas ' is the final outcome of aharaparinama or the metamorphosis of food into the tissue elements. It represents the essense of all tissues of the body and the vital energy which determines health, vigour, resistence to disease and longevity. Having hridaya (heart?] as its seat, it is stated to spread all over the body. Its physical characteristics have been described as viscous, extremely cold in virya, pure (clear and transparent) and reddish-yellow in colour.

complexion; alleviates *pitta*, toxic states and *vāta*; it allays thirst and burning sensation in the body. It has benificial influence on the health of the skin, hair, voice and promotes strength, cheerfulness, vitality and satisfaction. It renders the body roborant and firm, and acts as the healer of thoracic lesions. It enlivens the functions of the nose, mouth, throat, lips and the tongue, and allays the burning sensation felt inside the body. It relieves fainting. It is liked very much by bees and ants, and is viscous, cool and heavy."

तत्र, मधुरो रसः शरीरसात्म्याद्रसरुधिरमांसमेदोस्थिमज्जौजःशुक्राभिवर्धनः आयुष्यः षडिन्द्रियप्रसादनो बलवर्णकरः पित्तविषमारुतघ्नस्तृष्णादाहप्रशमनस्त्वच्यः केश्यः कण्ठ्यो बल्यः प्रीणनो जीवनस्तर्पणो बृंहणः स्थैर्यकरः क्षीणक्षतसन्धानकरो घ्राणमुखकण्ठौष्ठजिह्वाप्रह्लादनो दाहमूर्च्छाप्रशमनः षट्पदपिपीलिकानामिष्टतमः स्निग्धः शीतो गुरुश्च । (Charaka: Sutra 26; 1)

Āchārya Vāgbhata notes the following additional properties and actions of *swādu rasa :*

"As *madhara rasa* is *sātmya*[1] i.e., attuned to the body ever since its birth, it is capable of imparting strength to or promoting the tone of the *dhatūs* or tissues that support the body. It is invaluable to children as to the aged, in *kshatakāsa*[2] and to those suffering from *kshaya*.[3] It promotes the complexion, nourishes the

1. 'Satmya' means agreeable to nature or natural constitution; wholesome; suitableness; wholesomeness; habit; used to and community of (Samskrit-English Dictionary by Monier Williams).

2. 'Kshatakasa' is a condition which is marked by paroxysms of cough attended with haemoptysis, and which involves injury to the lungs and pleura.

3. The condition described as 'kshaya,' corresponds to tuberculosis of modern times.

hair and sense-organs, and promotes the formation of *ojas*.[1] In addition, it is *brihmana*,[2] promotes the voice, longevity and is *pittahara*, *vātahara* and anti-toxic. It also promotes the secretion of milk in the suckling mother and stimulates the healing process.

आजन्मसात्म्यात्कुरुते धातूनां प्रबलं बलम् ।
बालवृद्धक्षतक्षीणवर्णकेशेन्द्रियौजसाम् ॥
प्रशस्तो बृंहणः कण्ठ्यः स्तन्यसन्धानकृद्गुरुः ।
आयुष्यो जीवनः स्निग्धः पित्तानिलविषापहः ॥

THE EFFECTS OF EXCESSIVE INDULGENCE IN SWĀDU RASA

According to *Ayurveda*, the over indulgence in *swādurasa* is stated to contribute to the accumulation of fat in the body leading on to obesity. It has also been stated that certain diseases due to *kapha*, as well as the impairment of *agni* (or digestive process), the condition known as *sanyāsa* (corresponding to coma and convulsions), *prameha* (corresponding to glycosuria), *ganda* (corresponding to scrofulous glands in the neck), and *arbuda* (corresponding to malignant tumours), arise as a result of over-indulgence in *madhurarasa*.[3]

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1. 'Ojas' which has been described as a fluid, represents the quintessence and the sum-total of the energy of the tissues.

(Refer to foot notes in p. 99)

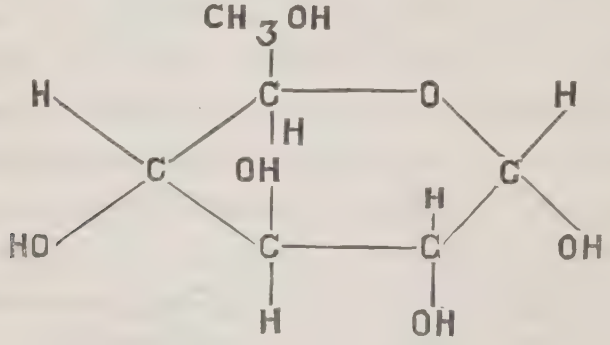
2. The term 'brihmana' means the fattening of the body due to the accumulation of adipose tissue.

3. Acharya Charaka notes: "Though madhura rasa possesses valuable properties, excessive indulgence in it results in the production of corpulance, softening of the tissues, lethargy, hypersomnia, heaviness of the body, lack of desire to eat, the impairment of agni (or the digestive process), asthenia, hypertrophy of the

(Continued in page 102)

The significance of many of the properties of substances possessing sweet taste described in *Ayurveda* in terse and aphoristic style as axiomatic truths can, better be appreciated, by a reference to some of the contributions of modern physiology.

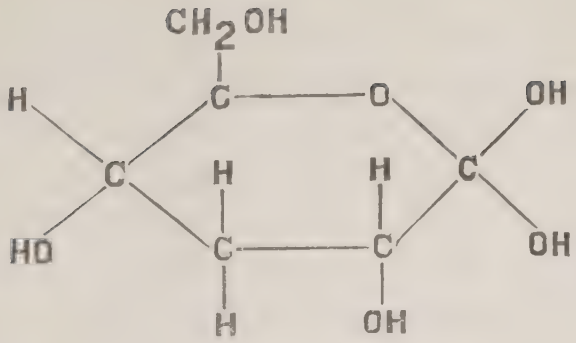
Substances which taste sweet or are sweetish, generally belong to the category of organic substances known as carbohydrates and a few to proteins, although some metallic compounds such as formate, acetate, proprionate and isovelerianate of lead as well as beryllium salts also give this taste. In the organic series, "the dihydric alcohols and sugars, typical of which are two glucoses



[∝-glucose (cis)]

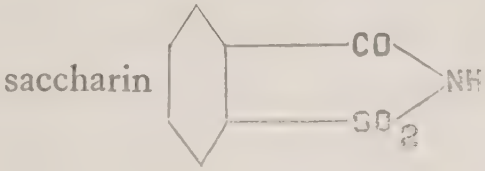
tissues in the mouth and throat, dysponea, cough, nasopharyngeal cattarh, intestinal stasis, fever preceded by chill, distension of the abdomen due to flatulance, the feeling of sweet taste in the mouth, vomiting, coma, loss of voice, scrofulous glands in the neck, elephantiasis, laryngitis, excessive secretion of mucous, discharge from the bladder, exudation from the blood vessels and throat, eye diseases with excessive lachrimation and such other diseases as are caused by the vitiated kapha".

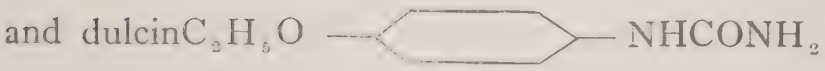
स एवंगुणोऽप्येक एवात्यर्थमुपयुज्यमानः स्थौल्यं मार्दवमालस्यमतिस्वप्नं गौरवमन्नाभिलाषमग्नेर्दौर्बल्यमास्यकण्ठयोर्मांसाभिवृद्धिं श्वासकासप्रतिश्यायालसकशीतज्वरानाहास्यमाधुर्यवमथुसज्ञास्वरप्रणाशगलगण्डगण्डमालाश्लीपदगलशोफवस्तिमेहनीगलोपलेपाढ्यामयाभिष्यन्दानित्येवंप्रभृतीन् कफजान् विकारानुपजनयति ।



[β-glucose]

which are generally sweet, both 74% of the sweetness of sucrose. Of the synthetics

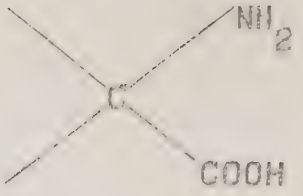




are best known. Erithritan and polygalitol, which are 1 : 4 and 1 : 5 anhydrides of erythritol and manitol respectively also posses sweet taste, although the former has a bitter taste in high concentration and the latter an astringent in high dilution." [1]

The α-amino acids, as noted by Fischer are sweet, although leucine $(CH_3)_2CH \cdot CH_2 \cdot CH(NH_2) \cdot COOH$, which occur in animal fluids, in the pancreas, spleen and glands, are only faintly sweet. The α-amino acids all contain Cohn's 'dulcigen' group

1. Carr, Beck and Krantz, J. Am. Chem. Soc., 58, 1934–5, 1936, quoted by Moncrieff in his 'Chemical Senses' p. 307 (1951 Edn).



amyto butyric acid, CH_3. CH_2CH. NH_2. COOH contains the glucophore $CH<^{NH_2}_{COOH}$ and auxogluc, C_2H_5 and is sweet.....Some of the sweet and sweet mixed taste substances listed by Cohn are :

Sweet : Glycol, glycerine, glycine, sugar, phloroglucinol, saccharin, dulcin.

Sweetish : γ–Dimethyl tartarate.

Tasteless and then sweet : Sodium napthionate.
Sweet and bitter : Glyceraldehyde, *p*-chlorosaccharin, *d*-valin.

Sweetish and bitter : Guaiacol ester of isovalerinic acid.
Sweetish and then bitter : Magnesium benzoate, butyramide.

Sweet and then bitterish : Methyl glyceraldehyde.
Sweetish and then bitterish : Ethyl butyrate."[1]

Carbohydrate, in the form of glucose is an indispensable component of blood. Its concentration in and about the cells in mammals is normally about 0.1% of the weight. It is stored up in the form of glycogen in the liver and muscles. While proteins are the building materials of the body and fat represents essentially a fuel reserve, the carbohydrate is in the main, readily available fuel substance. It also enters into the constitution of the

1. Chemical Senses by Moncrieff, p 308. (1951 Edn.)

protoplasm, especially the nucleus. The proper functioning of the body, including the various organs and special senses, is almost exclusively dependent on it. No particular disturbance of the cell activity may occur from a simple and uncomplicated increase in the concentration of the carbohydrate in the blood. But, if its level is appreciably reduced for any reason, a sharp increase in the irritability of certain nerve cells in the brain which are thrown into activity spontaneously i.e., by a multitude of very slight environmental changes ordinarily too small to stimulate normal cells, spontaneous muscular twitchings occur, which may ultimately develop into convulsions and loss of consciousness, leading ultimately to the death of the animal.

It will be seen from the foregoing that sugar is as important to the cell environment as salt, with this difference that, salt-ions directly influence the irritability of the nerve fibers and muscle tissues so that, a living cell removed from the body of an anaesthetised animal becomes highly irritable and twitch spontaneously if the muscle is bathed in a solution containing improper salt balance. But, in a proper salt-environment, the same isolated muscle shows no abnormal behaviour even when there is a complete absence of glucose in it. The fact that low blood sugar level is responsible for an increase in the irritability and activity of certain nerve cells in the brain resulting in the involuntary twitchings and convulsions in an animal, can be seen from experimental findings that when the connecting nerves of the muscle are severed, the twitchings and convulsions are found to be abolished In addition, the carbohydrate serves

as a protein sparer, in the sense that the former under conditions of starvation, effectively spares the utilisation of proteins for energy production, better than fats.

The carbohydrate or at least some component of its molecule can be converted into fat. Starches and sweets are known generally to fatten animals. Hogs, for example, are mainly fed with starches which have been shown to be responsible for the addition of fat in their body. Possible chemical reactions which may be concerned in the inter-convertability of carbohydrates and fats have been suggested. Glycerol is known to be produced in small quantities during the fermentation of glucose by yeast and it is considered possible that a similar production can occur in the body. The formation of fatty acids from pyruvic acid, which is an intermediary product of carbohydrate metabolism, has been suggested as a probability. It has also been suggested that the long carbon chain involving acetaldehyde may be concerned in the process, but definite evidence is wanting to establish that acetaldehyde can be formed from pyruvic acid by animal carboxylases. The details of synthesis is not yet fully understood, although it appears to be certain that fatty acids produced in the process combine with glycerol to form neutral fat. It has, however, been shown that the process of fat-production from carbohydrates requires the participation of vitamins belonging to the B group—aneurin and riboflavin as well as pantothenic acid—in the process.

In regard to proteins, some of the amino acids included under the categoty of the ' indispensables,' such as *d*–tryptophane, phenylalanine, tyrosine. iso-valine,

leucine, iso-leucine, and among the 'dispensables,' glycine, alanine, etc., are sweet. These are required by the cells of the body for the building up of their protoplasm.

The foregoing facts of modern physiology generally enforces the conclusions of *Vāgbhata* relating to the physiological actions of (substances–especially articles of food possessing) *madhura rasa* described earlier. in pages 99–101.

The effects of excessive indulgence in substances tasting sweet

The effects of excessive indulgence in substances tasting *madhurarasa*, as noted by the authors of *Charaka Samhita* and *Ashtānga Hridaya*, have to be liberally interpreted in respect of two important aspects, viz., (a) the consumption in excess of sugars, and (b) the impaired utilisation or the disposal of carbohydrates as a result of metabolic disturbances. For, the several effects noted by the two *āchāryās* include symptoms, some characteristic of digestive glycosuria and others, of hyperglycaemia. For example, the over-indulgence in carbohydrates or substances tasting *madhura rasa*, has been stated to result in the accumulation of fat in the body, leading to corpulance.

"एवात्यर्थमुपयुज्यमानः स्थौल्यं,"

Again, the administration of substances, predominantly sweet in taste are stated to produce *brihmana* or the fattening of the body––प्रशस्तो बृंहणः. Discussing the

food substances i.e., *āhāra dravyās* and actions or *vihārās* which produce *brihmana*, *Vāgbhata* lays emphasis on the liberal use of foods which contain carbohydrates and the adoption of measures calculated to conserve, instead of expending energy. Says *Vāgbhata*:

"*Brihmana* is successfully achieved by the administration of flesh, *milk*, *sugar*, and ghee; by the use of (nutrient) enemata containing substances which are predominantly *sweet* in taste and viscous in quality; the promotion of sleep, rest, and relaxation in bed; the leading of an easy-going life; the (habitual) use of oil baths; by the promotion of a care-free, happy, cheerful and an optimistic frame of mind."

मांसक्षीरसितासर्पिर्मधुरस्निग्धबस्तिभिः ॥
स्वप्नशय्यासुखाभ्यङ्गस्नाननिर्वृतिहर्षणैः ।

He further notes that, "one whose body has been wasted and has become emaciated, can be fattened like that of a hog by the administration of a diet predominantly *sweet in taste* and oily in nature, and by indulgence in pleasurable past-times."

मधुरस्निग्धसौहित्यैर्यत्सौख्येन च नश्यति ।

The prescription given by him for the promotion of *brihmana* in a wasted and emaciated person is even more significant.

"By the proper administration of foods, drinks and medicaments possessing the property of *brihmana*; by promoting a care and worry-free, cheerful and happy frame of mind; by the use of (health-promoting)

measures known as *tarpana*, and by ensuring adequate sleep, a person whose body is wasted and emaciated will soon become as fat as that of a hog."

अचिन्तया हर्षणेन ध्रुवं सन्तर्पणेन च ।
स्वप्नप्रसङ्गाच्च कृशो वराह इव पुष्यति ॥

(Ibid 34)

Symptoms characteristic of digestive glycosuria and hyperglycaemia

The reference made by *Vāgbhata*, as indeed by all other authorities of the ancient *Āyurvedic* classics, to the occurrence of *prameha* and *sanyāsa* which have been stated to result on account of over-indulgence in substances tasting sweet, necessitates an examination of the implications of these two terms in the light of facts of modern science. The condition known as *prameha* is characterised by polyurea. The urine, in this condition is stated to be turbid, being mixed with many kinds of waste products of the body.

सामान्यं लक्षणं तेषां प्रभूताविलमूत्रता ।

Twenty kinds of *pramehās* have been described in *Nidāna* of which, *ikshumeha* and *madhumeha* are conditions whose descriptions resemble those of the alementary or digestive glycosuria, and others, hyperglycaemia. It has, however, to be noted that the term *madhumeha* is generally applied to different kinds of polyureas included under the heading *prameha*, as according to the ancient medical authorities, (i) the neglect of the treatment of polyureas in their early stages

is stated to lead ultimately to *madhumeha* ; (ii) in all these conditions, the urine resembles honey in consistancy, and (iii) these conditions are stated to arise on account of an increase of sweetness in the body.

कालेनोपेक्षिताः सर्वे यद्यान्ति मधुमेहताम् ।
मधुरं यच्च सर्वेषु प्रायो मध्विव मेहति ॥

(Ash. Hri : Ni; 10; 20-21)

The reference here to ' the increase of sweetness in the body ' 'मधुरं यच्च सर्वेषु', is suggestive of alementary glycosuria in which sugar in excess of its normal concentration in the blood i.e., 0.1 per cent and above the level of the renal threshold is excreted through the urine, which resembles honey in consistency and taste. The use of the term *madhu* i.e., honey, instead of syrup or *pānaka*, both in respect of taste and consistency, is of significance. It is now known that honey contains fructose, sucrose and glucose. *Ikshumeha*, described as a condition in which the " urine resembles cane-juice and is sweet in taste " is an apt description of the urine of the alementary glycosuria.

इक्षो रसमिवात्यर्थं मधुरं चेक्षुमेहतः ॥

(Ibid 9)

Amla rasa or sour taste

Constitution : From the point of view of the *Pancha-bhūta* theory of Matter, substances tasting *amla* or sour are constituted predominantly with *agni* and *prithvi*. According to modern chemistry, substances tasting sour are acids—both mineral and vegetable, i.e., mineral and organic acids. Hydrochloric, nitric and sulphuric acids are examples of the former, and acetic, citric, malic and

fatty acids, are examples of the latter. All acids—organic or inorganic—ionise in aquous solution into an anion and cation, the latter invariably being the hydrogen. The greater the concentration of hydrogen-ion in a pure solution, the more pronounced is its sour taste. In other words, strong acids are highly ionised i.e., most of their molecules have dissociated into ions. Weak acids, such as those of vegetable origin, on the other hand, are not highly ionised and their solutions therefore, contain comparatively larger number of molecules from which ions have not dissociated. Sour taste, therefore, is generally proportional to the concentration of hydrogen ions. Stated in terms of *Āyurveda*, minerals as a rule are substances which contain *ākaraja tejas*, which is one of the different forms of *tejas* described by the *Nyāya* school. This system of natural philosophy posits two states of *tejas* viz., *nitya* or permanent and *anitya* or transient The former is *anu* or corpuscular in form and the latter *taranga* or waves, which become evident when the former is in motion i.e., when it performs *karma*.

Tejas has been stated to occur in nature in several forms viz., (i) *Tejas sarira* or the physical form of *tejas* which occurs in the form of solar-energy; (ii) *Indriya tejas* or the *tejas* present in the sensory organs, an examples of which is the form of *tejas* present as a point in the black of the eye corresponding to the retinal pigment or visual purple i.e., *ālochaka-pitta*; (iii) *Vishaya -tejas* or the *tejas* which occurs in the objects of the senses. This variety is of four kinds viz.,

(a) *Bhauma tejas* or the *tejas* of the earth, which may be illustrated with the examples of fire and the phosphorescence of the glow-worm;

(b) *Divya tejas* or the *tejas* of the sky: Examples of this variety of *tejas* are : the lightning, rays of the sun and of the other members of the stellar system. This variety includes the electro-magnetic phenomenon in the space.

(c) *Audarya tejas* or the *tejas* occurs in the gastro-intestinal secretions which are responsible for the digestion of foods and drinks. This variety includes *kāyāgni* or *dhātvagni* also.

(d) *Ākaraja tejas* or the *tejas* present in metals and minerals dug from the mines or radio-active and electro-magnetic substances.

The last variety of *tejas* is important to us in the consideration of the constitution of substances which taste *amla* or sour. *Amlarasa* or sour taste is experienced when the *āgneya* and *āpya* fractions of substances, predominantly *pārthiva* and *agneya* in constitution, are dessociated (*vibhāga*) during their *pāka* in the mouth.

The properties of amla rasa

Amlarasa is carminative in action and viscous in quality. It stimulates and supports the heart , promotes digestion and relish for food. It imparts strength to the supporting tissues, restores health to the body, and helps in the cleavage of substances. It is *ushna* in

virya and cool to touch, *laghu* in *guna*, provokes *kaphā*, *pitta* and *rakta*. It accelerates the action of the inhibited *vāyu*.

अम्लोऽक्षिदीतिकृत्स्निग्धो हृद्यः पाचनरोचनः।
उष्णवीर्यो हिमस्पर्शः प्रीणनः क्लेदनो लघुः॥
करोति कफपित्तास्रं मूढवातानुलोमनः।

In addition, *amla rasa*, stimulates (reflexly) an abundant secretion of saliva as though to cleanse the mouth, causes goose-skin, and chilly sensation in the teeth, as well as a shrinking sensation in the eye brows, and the contraction of the pupil.

.....अम्लः क्षालयते मुखम्।
हर्षणो रोमदन्तानामक्षिभ्रुवनिलोचनः॥

Excessive indulgence in *amla rasa*, on the other hand, produces incoordination of the parts and functions of the body, leads to the formation of the cataract of the eye, causes vertigo, itching sensation all over the body, palour, erysipelas, anasarca, blood-boils, thirst and pyrexia.

सोऽत्यभ्यस्तस्तनोः कुर्याच्छैथिल्यं तिमिरं भ्रमम्।
कण्डुपाण्डुत्वविसर्पशोफविस्फोटतृड्ज्वरान्॥

LAVANA RASA OR SALTISH TASTE

Substances possessing saltish taste are essentially *āpya* and *taijasa* in constitution. The characteristic salt taste is that of the common salt or *sāmudra lavana* i.e., sodium chloride. The chlorides of potassium, ammonium and calcium all taste similar to sodium

chloride. Hence the anion Cl and not the cation of Na^+, K^+ or C^{++} is responsible for the characteristic taste. "Whether sodium chloride solution was distinctly saline in taste at 0.04 molar, a similar solution of sodium acetate was not saline. Hence the saline taste must be due to Cl^- ion and not to the Na^+ ions."[1] It should, however, not be forgotten that sodium chloride would be more completely dissociated than the sodium acetate and that the concentration of Na^+ in the sodium chloride solution would be greater than in the sodium acetate solution. Moncrieff points out that "sodium bromide and sodium iodide are also salty. However, it is clear that the Cl^-, Br^-, SO_4^- or NO_3^- seems to be effective in producing saline taste, yet cation also has an effect. Otherwise, all chlorides would taste the same. Similarly the cation has a specific effect since all salts of sodium do not taste the same." According to Gyda Turin "the taste of salts was a function of both anion and cation" and that "potassium salts were exceptional, as the salty taste was more pronounced than predicted by rule."[2] In view of the large volume of investigations pursued on this subject in modern times, the conclusion that " " there is a general rule that low molecular weight salts are salty, while the high molecular weight salts are bitter."[3]

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1. Kahlenberg, Bull, Univ. Wisconsin, quoted by Moncrieff in his ' Chemical Senses' p. 136, (Edn. 1951).

2. Arch. Fisiol, 10, 175, 92 quoted by Moncrieff.

3. The "Chemical Senes" by Moncrieff (1951 Edn).

Salts and their importance to life

In the body fluids and cells are found dissolved a variety of salts of which the common salt or sodium chloride is the commonest. The other salts which play a vital role in the determination of the internal environment of the body are those of calcium, potassium, and magnesium. The concentration of these salts in the body fluid and cells of the body are nearly of the same order as those of the sea water. This fact has lent support to the theory that the origin of the first forms of life and the protoplasm was the sea, and the salts became an integral part of the protoplasm during the course of its evolution. According to this theory, with the evolution of the multi-cellular forms, the body fluids incorporated into the organism were simply the modified sea water taken from the immediate sea environment. Later, in the Cambrian period, when sea forms invaded the land, they carried with them in their body-fluids an environment very similar to the sea water. This view is borne by the fact that the composition of the body-fluids in land animals, including man, is only dilute sea water.

The concentration of salts in the body fluids of mammals is about 0.9 per cent of the body weight i.e., 9 gms. in 100 gms. of liquid. They are relatively simple, chemically. Nonetheless, salts exert profound influence on the activity of the cells. For example, a dimunition of calcium-ion concentration in cells or body-fluids, results in increased irritability. The cells, such as those of the skeletal muscles, begin to twitch spontaneously. Considerable lowering of the blood

calcium in mammals leads to convulsion and death. A proper balance of sodium, calcium and potassium-ions is indispensable for the normal action of the muscle cells of the heart. This can be illustrated by the fact, that in a pure solution of sodium chloride, frog's heart soon stops beating in the state of relaxation. On the other hand, the heart stops in a state of maintained contraction in a solution containing sodium and calcium, and not potassium. Too much of potassium stops the heart in a state of relaxation. It is only when the ions of these three salts are present in proper concentration will the heart continue to work normally. The deprivation of salts, especially the sodium chloride i.e., *sāmudra lavana*, results in muscular and mental weakness, vomiting and diarrhoea. Salts are responsible for the osmotic exchanges which are constantly going on in the human body. The importance of salts in the preservation of the fluid-balance of the body can hardly be exaggerated. The process of osmosis, which is largely determined by salts, is a great conservator of energy, of respiratory inter-change and metabolism.

The facts stated above generally bear out the description of the properties, actions, uses and abuses of substances which taste saltish as given by *Charaka* and *Vāgbhata*. Says *Vāgbhata*:

"*Lavana rasa* brings about the shrinkage of the organs and tissues of the body, produces dryness, relieves constipation and improves digestion. It promotes viscosity, possesses diaphoretic action and is keen in quality (sharp or penetrating). It improves the taste in the tongue, causes lysis and separation."

लवणः स्राम्भसङ्घातबन्धविध्मापनोऽग्निकृत् ॥
स्नेहनः स्वेदनस्तीक्ष्णो रोचनश्छेदभेदकृत् ।

Charaka observes :

"*Lavana rasa* is stomachic, causes liqufication (and exudation); possesses carminative action and induces defluxion, promotes; lysis and separation; it is keen (penetrating), flowing, diffusive, laxative (cathartic), diobstruent; allays *vāta* and stiffness, and clears obstructions and accumulations. It over-powers all other tastes and causes salivation, promotes the liquification of phlegm; cleanses the pathways, softens the organs of the body, and promotes relish for food. It is an important and necessary constituent of nutrition. In quality, it is neither very heavy nor quite viscous, and is *ushna* (in *virya*).

लवणो रसः पाचनः क्लेदनो दीपनश्च्यावनश्छेदनो भेदनस्तीक्ष्णः स्रो विकास्यश्वःस्यश्वकाशकरो वातहरः स्तम्भबन्धसङ्घातविध्मापनः सर्वरसप्रत्यनीकभूतः आस्यमास्रावयति, कफं विष्यन्दयति, मार्गान् विशोधयति, सर्वशरीरावयवान् मृदूकरोति, रोचयत्याहारम्, आहारयोगी, नात्यर्थं गुरुः स्निग्धश्च उष्णश्च ।

Effects of excessive indulgence in saltish taste

Vāgbhata describes the effects of over-indulgence in (substances possessing) saltish taste as follows :

"Over indulgence in saltish taste leads to *vātārakta* (neuritis), alopecia, the greying of the hair, wrinkling of the skin, thirst, causes skin diseases (*kushta*),[1] toxic states, erysepelas (*visarpa*) and depletes the strength of the body."

1. Skin diseases have been classified under two groups viz., *kushta* (corresponding to different forms of leprosy, and *kshudra kushta* which comprises of different kinds of non-leprotic and obstinate skin diseases)

सोऽतियुक्तोऽम्लपवनं खलतिं पलितं वलिम् ॥
तृट्कुष्ठविषवीसर्पान् जनयेत्क्षापयेद्बलम् ।

Notes *Charaka* :

"Though possessed of all these qualities (already mentioned above), if used in excess, saltish taste (i.e., substances possessing saltish taste) provokes *pitta*. It promotes the increase of blood; causes thirst, coma, heat, lysis, and dehydration of the muscle tissue. It exacerbates cutaneous affections (*kushta* including *kshudra-kushta* or obstinate skin lesions like excema, psoriasis, dermatitis, lupus, acne, scabies etc., augments toxic states; bursts oedematous swellings; causes the shedding of the teeth; impairs manliness and the functions of the sense organs; produces wrinkling of the skin, greying of the hair and baldness of the head."

स एवंगुणोऽप्येक एवात्यर्थमुपयुज्यमानः पित्तं कोपयति, रक्तं वर्धयति, तर्पयति, मूर्च्छयति, तापयति दारयति, कृष्णाति मांसानि, प्रगालयति कुष्ठानि, विषं वर्धयति, शोफान् स्फोटयति, दन्तांश्च्यावयति, पुंस्त्वमुपहन्ति, इन्द्रियाण्युपरुणद्धि, वलीपलितखालित्यमापादयति,

He adds: "In addition, excessive indulgence in it predisposes to haemorrhagic states, hyper-acidity (of the stomach), erysipelas, neuritis, scabies, alopecia and the rest".

अपि च लोहितपित्तामलपित्तवीसर्पवातरक्तविचर्चिकेन्द्रलुप्तप्रभृतीन्विकारानुपजनयति ।

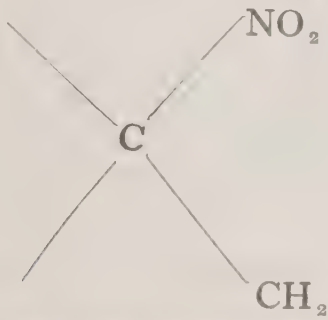
Tikta rasa or bitter taste

Tikta rasa or bitter taste is found in a variety of substances. As pointed out by Gosh, the quality of bitterness is widely distributed throughout the vegetable kingdom. "Bitterness is a property of the alkaloids

such as strychnine and quinine, and of many innocous substances such as quassia Mg^{++}, Ca^{++} NH_4^+, and perhaps, nearly all cations have bitter taste, and so have ether, most glucosides and some other substances."[1] To this may be added picric acid. As the molecular weight increases, there is a gradual change in the taste of salts from saline to bitter. For example, whereas sodium chloride is typically saltish, caseium chloride is bitter. The same is also true in the case of sweet substances. The sweetish taste of many organic substances gradually yield bitter taste with the increase in their molecular weights. Cohn has noted that the "lower members of a homologous series will be sweet but higher members bitter."[2]

Magnesium and ammonium salts are usually bitter-this taste being attributed to Mg^{++}ion. It is of interest to note that magnesium is the next member in the group of which beryllium (sweet salts) is the first member. Calcium which comes next in order in this group, also gives bitter salts.

Bitterness, as shown by Henry (Compt. rend., 121, 213, 1895)[3] is usually associated with the group



1. Winton and Bayliss; "Human Physiology," 1948 Edn. p. 539.
2. Cited by Moncrieff in his "Chemical Sense" 1951 Edn. p. 147.
3. Quoted by Mancrieff in his "The Chemical Senses" 1951 Edn. p. 147.

An example of the change from sweet to bitter on ascending homologous series are the betaines of amino-acids. Khun and Giral (Z. Physiol, Chem. 231, 208-9, 1895) showed that while valerobetine and caprobetine had transient sweet tastes, the betine of amino-pentadecylic acid was bitter. The threshold value of bitter taste is 0.00005 per cent of quinine.

According to Gosh, "many drugs while possessing the bitter taste have other and more important actions which overshadow the bitter quality".[1] He instances the examples of nux vomica on the nervous system, and quinine as an anti-periodic. He, however, notes: "on the other hand, bitterness is the only quality of the drugs of this group and their therapeutic uses are linked with this property. Bitters, in this sense, form a class of the larger group of stomachics".[2] "Bitter stomachics increase functional activity of the digestive organs."[3]

According to *Āyurvedā*, bitter taste is stated to occur in compounds which are constituted predominantly by *ākāsa* and *vāyu bhūtās*. *Vāgbhata* describes the properties of this taste as follows:

"Even though *tikta rasa* is itself an unpleasant taste, it clears and cures distastes caused by various other factors. It possesses anthalmentic and bactericidal properties and is anti-toxic. It is valuable in the

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1. R. N. Gosh: "Pharmacology, Meteria Medica and Therapeutics", 1949 Edn. p. 349–50.

2 Ibid.

3. Dilling: "The Pharmacology and Therapeutics of the Materia Medica", 1943 Edn. p. 171.

treatment of obstinate skin diseases, like *kushta* (including *kshudra kushta*), loss of consciousness (comatose states), pyrexias, salivation, inflammatory reactions, billiousness, and bile and phlegmatic disorders. It controls exudative reactions, reduces excessive accumulation of fat in the body, dries up *vasa*,[1] *majja*,[2] and excrements such as faeces, urine etc. Substances possessing *tiktarasa* are *laghu* or light and dry in quality, they promote *meda* or intelligence and intellect, and are *sita* in *virya*. In addition, *tikatarasa* clears the throat and promotes the voice, and cleanses the breast milk."

तिक्तः स्वयमरोचिष्णुररुचिं कृमिमूर्छाविषम् ॥
कुष्ठमूर्छाज्वरोत्क्लेशदाहपित्तकफान् जयेत् ।
क्लेदमेदोवसामज्जशकृन्मूत्रोपशोषणः ॥
लघुर्मेध्यो हिमो रूक्षः स्तन्यकण्ठविशोधनः ।

Says *Charaka*:

"The bitter taste, though distasteful in itself, cures distastes caused by other causes; it is anti-toxic and parasiticidal. It cures fainting and coma, alleviates burning sensation in the body, itching sensation in the skin, dermatitis, and thirst. It tones up the skin and muscles, and possesses anti-pyretic action. It is stomachic, carminative and a cleanser of breast milk, depletive, desciccant of exudates, fat, *vasa*,[1] *majja*,[2] *lasika*,[3] *pūya* (or pus), sweat, urine, faeces, bile and phlegm. In quality, it is dry and light. In *virya* it is *sita*."

1. 'Vasa,' is an oily or fatty exudate,

2. 'Majja,' is bone marrow, especially the red. In the present context it is the yellow bone-marrow.

3. 'Lasika' is serum.

तिक्तो रसः स्वयमरोचिष्णुरप्यरोचकघ्नो विषघ्नः क्रिमिघ्नो मूर्च्छादाहकण्डूकुष्ठ-तृष्णाप्रशमनस्त्वग्मांसयोः स्थिरीकरणो ज्वरो दीपनः पाचनः स्तन्यशोधनो लेखनः क्लेदमेदोवसामज्जालसीकापूयस्वेदमूत्रपुरीषपित्तश्लेष्मोपशोषणो रूक्षः शीतो लघुश्च ।

Vāgbhata notes that over indulgence in substances possessing *tiktarasa* or bitter taste leads (or predisposes) to the wasting of tissues; and *vātic* or nervous disturbances.

धातुक्षयानिलव्याधीनतियोगात्करोति सः ॥

Charaka notes the following as the outcome of an excessive use of substances possessing *tiktarasa* or bitter taste :

"Though possessed of valuable properties (mentioned already), excessive use of substances possessing *tiktarasa* or bitter taste, leads to the drying up of the *rasa* or tissue-fluids, *rudira* or blood tissue, *māmsa* or muscle tissue, *medas* or adipose tissue, *asti* or bone tissue, *majja* or marrow (yellow and red) and *sukra* or the reproductive elements, on account of its *rūksha* or rough, *khara* or dry and *visada* or transparent qulities. It renders the *srotas* or channels (conduits or pathways of the flow of *vāta* or nerve-impulses, arterial and venous blood and lymph), *khara* or roughness, and predisposes to asthenia and wasting; causes the loss of cheerfulness of the mind, delusion, fainting, dryness of the mouth and different kinds of *vāta* disturbances."

स एवंगुणोऽप्येक एवात्यर्थमुपयुज्यमानो रौक्ष्यात्खरविषदस्वभावाच्च रसरुधिरमांस-मेदोऽस्थिमज्जायुक्तान्युच्छोषयति, स्रोतसां खरत्वमुपपादयति, बलमादत्ते, कर्शयति, ग्लपयति, मोहयति, भ्रमयति, वदनमुपशोषयति, अपरांश्च वातविकारानुपजनयति ;

The effects of the proper use and abuse of substances possessing bitter taste, as recorded in *Ayurveda* can be better appreciated by taking into consideration the observations of Dr. Gosh regarding vegetable bitters, already referred to in pages 118-120. Apart from the important actions and effects which vegetable bitters possess, the fact that "Bitterness is the only quality of the drugs of this group and their therapeutic uses are linked up with it," is significant. The examples of nux-vomica and quinine will suffice to illustrate the two kinds of effects. Both these substances, used in small and proper doses are excellent stomachics and tonics. They relieve constipation and are cardiac and respiratory stimulants. Likewise, they are also mild stimulants of higher cerebral centres. Both of them exert powerful influence on the nervous system. They augment the capacity for muscular work and delay the onset of fatigue. They also exert a beneficial influence on the metabolism. On the contrary, it is well known that an excessive indulgence in these substances, is fraught with serious and disastrous consequences of the type visualised by *Charaka* and *Vāgbhata*

Katurasa or acrid (pungent) taste

Substances possessing *katurasa* or acrid i.e., pungent taste are, according to *Ayurveda*, composed of compounds which are predominantly *tejas* and *vāyu* in constitution.

According to *Vāgbhata*, substances tasting *katu* i.e., acrid, are valuable in the treatment of diseases of the throat, *udarda* or dermatitis, *kushta* (including *kshudra kushta* i.e., leprosy and other forms of non-leprotic but

obstinate skin diseases), *alasaka* or gastric stasis and distention due to the decomposition of food, *sopha* or dropsy and general anasarca. It destroys *vranās* or ulcers and dries up oily, fatty and such other exudates. Substances possessing this taste are carminatives and stomachics, and they impart relish for food. They help in the radical removal-of toxic substances from the body. They are also capable of dehydrating food substances. In addition, they cause the separation of matter obstructing the *srotas* and dilate the latter. They are capable of clearing disturbances of phlegmatic origin.

कटुर्गलामयोदर्दकुष्ठालसकशोफजित् ।
व्रणावसादनः स्नेहमेदःक्लेदोपशोषणः ॥
दीपनः पाचनो रुच्यः शोधनोऽन्नस्य शोषणः ।
छिनत्ति ग्रन्थीन् स्रोतांसि विवृणोति कफापहः ॥

Charaka notes the following as the properties and effects of *katurasa* i.e., acrid or pungent taste :

"*Katurasa* cleanses the mouth, stimulates the gastric fire (secretions) ; desiccates food, causes the nose to run and eyes to water; increases the acuity of the sensory organs ; relieves intestinal tropor and dropsy; cures obesity, dermatitis, putrefactive decompositions, unctuousness, (excessive) sweating, and softening (of the tissues) ; helps in the elimination of waste-products of the body ; imparts relish for food ; relieves pruritis and cheeks the formation of excessive granulations. It possesses anthelmentic action ; breaks up the muscle tissue ; clears the accumlation of blood and obstructions; dilates the passages and allays *kapha*. It is light, hot and dry."

कटुको रसो वक्त्रं शोधयति, अग्निं दीपयति, भुक्तं शोषयति घ्राणमास्रावयति, चक्षुर्विरेचयति, स्फुटीकरोतीन्द्रियाणि, अल्पकफपित्तपूयपूर्वदोषाभिष्यन्दस्नेहस्वेद-क्लेदमप्यनुपहन्ति, रोचयत्यशनं, कण्डूर्विनाशयति, व्रणानवसादयति, क्रिमीन् हिनस्ति, मांसं विलिखति, शोणितसङ्घातं भिनत्ति, बन्धांश्छिनत्ति, मार्गान् विवृणोति, श्लेष्माणं शमयति, लघुरुष्णो रूक्षश्च ।

Effects of excessive indulgence in katu rasa or acrid (pungent taste)

Says *Vāgbhata:* "Over-indulgence in substances tasting *katu* i.e.,acrid or pungent leads to excessive thirst, the inhibition of the production of the reproductive elements; causes asthenia, coma, constriction of the organs of the body, and pain in the back and waist."

कुरुते सोऽतियोगेन तृष्णां शुक्रबलक्षयम् ।
मूर्च्छामाकुञ्चनं कम्पं कटिपृष्ठादिषु व्यथाम् ॥

Says *Charaka*: "Though possessed of valuable qualities, if over indulged, *katurasa impairs* manliness on account of the action of (the products of) its *vipāka*. Both due to its *rasa* and *virya*, it produces delusion of the mind, causes weariness, asthenia, wasting of the body, fainting fits, bending or hunching of the body, suffocation, exhaustion, vertigo and burning sensation in the throat. It also causes great heat in the body, diminishes strength and produces thirst".

स एवंगुणोऽप्येक एवात्यर्थमुपयुज्यमानो विपाकप्रभावात् पुंस्त्वमुपहन्ति, रसवीर्यप्रभावान्मोहयन्ति, ग्लापयति, सादयति, कर्शयति, मूर्च्छयति, नमयति नमयति, भ्रमयति, कण्ठं परिदहति, शरीरतापमुपजनयति, बलं क्षिणोति, तृष्णां जनयति ;

From facts made available by modern science relating to the properties of substances, such as the pungent spices, viz., nutmeg, cinnamom, ginger, cassia

pepper, papirka etc., which possess acrid or pungent taste, it is seen that they act by irritation, and cause mucous flow, sneezing and lachrimation. These reactions are, it is held, calculated to remove the irritating substances. The appreciation of such substances is made possible by their tastes. Pepper for example, is recognized on account of (i) its pleasant sweetish taste and (ii) its irritant action on the common chemical sense receptors in the mouth in special and all over the body in general. The same also the case with ginger. It is recognised on account of its hot and spicy taste, which is somewhat milder than pepper. It produces burning and irritant action like pepper and is acrid or pungent in taste. These are but few examples of substances which possess acrid or pungent taste. There are, however, many other substances which are distressingly pungent. These substances cause painful burns on the skin in high concentrations, e,g., 20 per cent aquous solution, as also in the eyes leading to temporary blindness.

As already pointed out in pages 97-98, the sensation this taste evokes, which is experienced as acridity, has been shown to be really the sensation of irritation due to the stimulation of the pain and heat receptors in the tougue. None the less, the inclusion of this taste among the *shadrasās* by *Ayurveda* appears to be justified from the fact, that within normal and bearable limits, substances tasting acrid evoke (reflexly) the flow of saliva in the mouth, and the gastric juice in the stomach, as well as create a pleasurable sensation of relish.

As compared to countries in the west where substances possessing acrid taste are not usually included in or added to foods, the Indian diet, especially in the south, will be considered insipid and unappetising in the absence of this taste. It is in the ordinary experience of south Indians, that the very mention of '*kara chatni* and pickles is sufficient to cause the watering of the mouth and the feeling of a relish for food. The absence of specific areas and taste-buds in the tongue for this taste is obviously compensated by the action of higher cortical centres which are stimulated by the sight and thought of foods which are pleasantly acrid in taste. Stated in brief, the use of this taste is a conditioned reflex in Indians, hence perhaps is the reason why they have been added to the four main tastes, viz., sweet, acid, salty and bitter.

Kashāyarasa or astringent taste

Substances possessing *kashāyarasa* or astringent taste are composed of compounds which are essentially *prithvi* and *vāyu* in constitution. These substances, according to *Vāgbhata*, allay disturbances engendered by *pitta* and *kapha*. Such substances are, as a rule *guru* and *ruksha* in *guna* (the quality of being heavy), *sita* in *virya* and are capable of purifying the blood, produce constriction of organs and heal ulcers. *Kashāyarasa* possesses the property of drying up of the tissue-exudate known as *kleda* and adipose tissue. It retains *āmadosha* (auto-intoxication) and increases the same, and promotes retention i.e., *grāhi*. In addition, it can produce excessive tanning of the skin.

कषायः पित्तकफहा गुरुरस्रविशोधनः |
पीडनो रोपणः शीतः क्लेदमेदोविशोषणः ||
आमसंस्तम्भनो ग्राहिरूक्षोऽतित्वक्प्रसादनः |

Observes *Charaka* : "The *kashāyarasa* or astringent taste is sedative and astringent in action, promotes retention and union (especially the union of injured parts and fractured bones). It possesses compressive action, heals injuries, dries up moisture, is styptic and allays disturbances engendered by *kapha*, *rakta* and *pitta*. It dries up tissue exudates, is dry in quality, *sita* in *virya* and it is not light in quality".

कषायो रसः संशमनः संग्राही सन्धानकरः पीडनो रोपणः शोषणः स्तम्भनः श्लेष्मरक्तपित्तप्रशमनः शरीरक्लेदस्योपयोक्ता रूक्षः शीतोऽल्पगुश्च |

"Excessive use of substances possessing astringent taste produces distention of the abdomen, provokes the disturbance of *vāta*, causes praecardial pain, thirst, asthenia, impotency, obstrurtion or obliteration of the channels of circulation of biological fluids and the retention of faeces."

करोति शीलितः सोऽतिविष्टम्भाध्मानहृद्रुजः ||
तृट्कार्श्यपौरुषभ्रंशस्रोतोरोधमलग्रहान् |

Says *Charaka* : "Although possessed of valuable qualities, the exclusive use or use in excess of substances possessing *kashāya* or astringent taste produces dryness of the mouth ; affects the heart ; causes distention of the stomach ; impedes speech ; constricts the body channels; produces cyanosis ; and impairs manliness It is slowly digested, if retained in the body and causes the retention of flatus, urine, faeces and sperm. It produces

wasting, weariness and stiffness of the body, and thirst. Due to its rough, transparent and dry qualities, it provokes various kinds of *vāta* disturbances, such as haemaplegia, spasms, convulsions and facial paralysis."

स एवंगुणोप्येक एवात्यर्थमुपयुज्यमानः आस्यं शोषयति, हृदयं पीडयति, उदरमाध्मापयति, वाचं निगृह्णाति, स्रोतांस्यवबध्नाति श्यावत्वमापादयति, पुंस्त्वमुपहन्ति, विष्टम्भ्य जरां गच्छति, वातमूत्रपुरीषाण्यभ्यवगृह्णाति, कर्शयति, तर्षयति, स्तम्भयति स्वरविशदत्वक्षत्वात् पक्षवधप्रभृतीनां च दारुणानां वातविकारानुपजनयति ॥

The properties ascribed by *Āyurveda* to *kahāyarasa* or astringency are in general, supported by facts of modern pharmacology and therapeutics, according to which: "*Astringents from a special group of drugs whose action is characterised by contraction or shrinkage of the tissues and diminished exudation or secretion* (italics mine). In the intestine, their effects are antagonistic to purgatives. They include astringent metals, acid sulphuric dilute, and vegetable astringents. Opium and chalk act as intestinal astringents by diminishing the secretion and peristalsis.

"The vegetable astringents owe their property to the presence of tanin. They precipitate proteins and form a blue or black compound with iron preparations. They are milder in their effects than the astringent metals, and being practically harmless, they are specifically used in diseases of the alimentary canal. *All astringents are local haemostatics* (italics mine) i.e., they check bleeding by precipitating a hard coagulum which plugs the vessels. Since astringents are precipitated by proteins, *they are not much abosrbed* (italics mine), nor

do they exist in blood and tissues in sufficient quantity to be of any use "[1]

What was stated in respect of the reasons for the inclusion of *katu* i.e., acrid or pungent taste as one among the *shadrasās*, will hold good to *kashāyarasa* or astringent taste also, with this difference that, the sensation felt in the tongue as *kashāyarasa* or astringent taste is caused by the shrinkage of the mucosa of the mouth and the stimulation of the chemo-receptors therein. Nearly the same sensation is experienced when astringent substances are applied to mucous membranes elsewhere or to raw surfaces.

The Classification of substances into groups on the basis of their tastes

Āhāra or dietic and *aushadha* or medicinal substances have been classified *in Ayurveda* under distinct groups, i.e., *vargās* or *ganās*, as the case may be, on the basis of :

(i) Their *panchabhutic* or physico-chemical constitution. These are five in number, viz.,

(a) *pārthiva*,
(b) *āpya*,
(c) *āgneya*,
(d) *vāyavya*, and
(e) *nābhasya*.[2]

(ii) Their *rasa* or taste, into six groups or *vargās*, viz.,

(a) *madhura varga* or those which belong to the sweet group ;

1. Gosh, "Pharmacology, Materia Medica and Therapeutics", pp. 383-84. 1949 Edn.

2. Nabasya is akasa.

(b) *amla varga* or those which belong to the acid or sour group ;

(c) *lavana varga* or those which belong to the salt group ;

(d) *tikta varga* or those which belong to the group of bitters ;

(e) *katu or ūshana vargā* or those which belong to the group of acrids, and

(f) *kashkya varga* or those which belong to the group of astringents.

(iii) Their therapeutic properties, such as *pāchana* or carminatives ; *dipana* or stomachics ; *virechana* or purgatives ; *mūtrala* or diuretics and *jwargna* or anti-pyretics and the like.

We are, in the present context, concerned with the classification of substances into *vargās* or groups on the basis of their *rasās* or tastes. Each *varga* comprises of *āhāra* and the *aushdha dravyās* (both organic and inorganic). Substances included in each *varga* are not furnished here as they properly belong to the subject '*dravya guna*' or 'pharmacology, materia medica and therapeutics' and which may have to be dealt with separately.

Rasās and viryās

Of the *shadrasās* or six tastes, *katu*, *amla* and *lavana* possess, consecutively *ushnavirya* in progressively increasing degrees. Likewise, *tikta*, *kashāya* and *madurarasās* possess consecutively *sitavirya*, in progressively increasing degrees :

: कटुम्ललवणा वीर्येणोष्णा यथोत्तरम् ॥
तिक्तः कषायो मधुरस्तद्वदेव च शीतलाः ।

The properties of rasās in binding the bowels or in the elimination of waste-products

Tikta, *katu* and *kashāya rasās* consecutively possess the property of binding the bowels in progressively increasing degrees due to the progressive increase in the *rukshta* or dryness of substances possessing these tastes. Likewise, *lavana*, *amla* and *madhurarasās* which consecutively possess, progressively increasing degrees of *snigdhatva* or viscosity, which is the opposite of *rūkshtva* possessed by the former tastes, are capable of ensuring proper elimination of the *malās* or waste-products of the body.

तिक्तः कटुः कषायश्च रूक्षा बद्धमलास्तथा ॥
पटुम्लमधुराः स्निग्धाः सृष्टविण्मूत्रमारुताः ।

Gurutva and laghutva of rasās

The property of *lavanarasa* is *guru*. *Kashāyarasa* is superior to *lavana* in *gurutva* and *madhurarasa* is superior in *gurutva* as compared to the first two *rasās* mentioned above. In the same way, the property of *amlarasa* is *laghu*. *Katurasa* is superior to *amlarasa* in *laghūtva* and *tiktarasa* is superior in this quality as compared to *amla* and *katu rasās*.

पटोः कषायस्तस्माच्च मधुरः परमं गुरुः ॥
लघुरम्लः कटुस्तस्मात्तस्मादपि च तिक्तकः ।

The characteristics of dravyās according to their bhautic constitution

1. *Pārthiva dravyās*: Substances which are predominantly *pārthiva* in nature, exhibit such physical characteristics as heaviness, grossness, stability, and possess the property of smell i.e., they are capable of an olfactory appeal. Such substances produce heaviness, possess the capacity to integrate or weld together and promote growth.

तत्र द्रव्यं गुरुस्थूलस्थिरगन्धगुणोल्बणम् ॥
पार्थिवं गौरवस्थैर्यसङ्घातोपचयावहम् ।

2. *Āpya dravyās*: Substances as are predominantly *āpya* in nature, possess the property of fluidity, heaviness, viscosity, dullness and cognizability. They are capable of making a gustatory appeal and promoting viscosity. Loosening, spreading over, moistening, permeate through, disintegrate and exude, are other properties they possess. They cause satisfaction and exhilaration of the spirit and promote the linking of substances or keep the things in position, and bring the broken parts together.

द्रवशीतगुरुस्निग्धमन्दसान्द्ररसोल्बणम् ॥
आप्यं स्नेहनविष्यन्दक्लेदप्रह्लादबन्धकृत् ।

3. *Āgneya dravyās*: Substances as are predominantly *āgneya* in nature are dry, penetrating, hot (or heat producing), transparent (to make known, to illumine) and subtle. They have the attirbute of form or image, produce inflammatory reactions, glow, impart sensations of colours, illumine and activate chemical reactions (of the catabolic or breakdown type).

रूक्षतीक्ष्णोष्णविशदसूक्ष्मरूपगुणोल्बणम् ||
आग्नेयं दाहभावर्णप्रकाशपचनात्मकम् ।

4. *Vāyavya dravyās* : Substances which are predominantly *vāyavya* in nature are dry, possess extensibility and transparency and make a tactile appeal. They produce dryness (and roughness), promote lightness, clearness, cause anxiety-states in the mind and the emaciation of the body.

वायव्यं रूक्षविशदलघुस्पर्शगुणोल्बणम् ||
रौक्ष्यलाघववैशद्यविचारग्लानिकारकम् ।

5. *Nābhasa dravyās*: Substances which are predominantly *nabhas* in nature are subtle, dry, transparent (clear) and light. They make for an auditory appeal. Such substances produce lightness, exhibit porosity and posses the capacity to occupy and fill up spaces.

नाभसं सूक्ष्मविशदलघुशब्दगुणोल्बणम् ||
सौषिर्यलाघवकरम्..... ।

Arising out of the comprehensive outlook of the theory of the *panchabhautic* constitution of Matter, corresponding to the 'New Outlook in Physics',[1] *Vāgbhatāchārya* proceeds to postulate a far-reaching concept in the following terms .

"Taking a wide and comprehensive view of their utility and applicability in all cases and for all purposes, there is no substance in the universe which is not an *aushadha*".

.....जगत्येवमनौषधम् ।
न किञ्चिद्विद्यते द्रव्यं वशान्नानार्थयोगयोः ||

1. For the New Outlook in Physics and Panchabhuta theory, refer to pp. 81-82 of the Fundamental Principles of Ayurveda, Part II, The Out lines of the Samkhya Patanjala System" by the author.

Two main classifications of dravyās

Notwithstanding the fivefold general classifications of *dravyās* or substances on the basis of their physico-chemical constitution mentioned above, a further classification of them under two groups, viz., those that exhibit the property of movement upwards, and others which exhibit the property of downward movement, has been made. The former, known as the *ūrdhvagāmi*, are predominantly *āgneya* and *vāyavya* in nature, while those described as *adhogāmi* are essentially *pārthiva* and *āpya* in nature:

द्रव्यमूर्ध्वंगमं तत्र प्रायोऽग्निपवनोत्कटम् ।
अधोगामि च भूयिष्ठं भूमितोयगुणाधिकम् ॥

"Substances which move upwards are predominantly of the *āgneya* and *vāyavya* types and are known as *ūrdhvagāmi*, and those which move downwards are predominantly of *pārthiva* and *āpya* types, and they are known as *adhogāmi*."

Arunadatta, an authoritative commentator of *Ashtānga Hridaya* and his *tika* writer, *Hemādri*, have interpreted the above classification to comprehend substances which are predominantly *āgneya* and *vāyavya* in nature and which act as emitics, such as *madana-phala*, and those which are *pārthiva* and *āpya* in constitution are purgatives, such as *trivruth* etc. In general, they hold that *dravyās* employed for use in *sodhana kriyās*, such as *vamana* and *virehana*, are cited as examples of *ūrdhvagāmi* and *adhogāmi* respectively. In the same way, these terms have been used to include the two kinds of therapies of *Ayurveda* viz., *sodhana* and

samana, which have again been classified into (a) *sodhanās* of the *ūrdhvagāmi* and *adhogāmi* types. Substances, as are predominantly *āgneya* and *vāyavya* in nature, are stated to produce *ūrdhvagamana soūhana* effected by *vamana* or emises; (b) substances as are predominantly *pārthiva* and *āpya* in nature are stated to produce *adhogamana sodhana* by *virechana* or purgation, and (c) substances in which *ākāsa* is predominant are stated to produce *samana*.

This way of interpreting the concepts of *ūrdhvagāmi* and *āhogāmi*, is apparently narrow, and a misfit in the context of a discussion bordering on the properties of *dravyās vis a vis* their *pānchabhutic* constitution, at a fundamental level. The reference here is to the two essential properties of substances viz., *guna* and *karma*, judged from the point of view of the physico-chemical properties of the *bhūtās* that compose them. The term *guna*, it was seen earlier, represents qualities experienced (subjectively or empirically). Some of them can also be stated quantitatively, as in the case of *gurutva* (gravitation) and *laghutva* (levity). On the other hand, it was seen that *karma* is action, behaviour such as effort, endeavour etc., i.e., an endeavour or action directed towards an end.

Says Charaka :

सार्था गुर्वादयो बुद्धिः प्रयत्नान्ताः परादयः ।
गुणाः प्रोक्ताः प्रयत्नादि कर्म चेष्टितमुच्यते ॥
प्रवृत्तिस्तु खलु चेष्टा कार्यार्था, सैव क्रियाकर्म, यत्नः कार्यसमारम्भश्च ॥

This has a direct reference to the properties implicit in Matter i.e., atoms i.e., *anūs* or *pilūs* and molecules or *pitharās* which compose them. Says *Charaka* :

संयोगे च विभागे च कारणं द्रव्यमाश्रितम् ।
कर्तव्यस्य क्रियाकर्म कर्म नान्यदपेक्षते ॥

[Charaka, Sutra 1; 52]

"Action which is the cause of combination and separation resides in the substance itself. Action is the performance of what is to be done. It depends on nothing else."

The classification of *karma* into five different kinds of motion is of significance viz.,

(1) *Utkshepana* or upward movement ;
(2) *Apakshepana* or downward movement ;
(3) *Ākunchana* or contraction and narrowing ;
(4) *Prasārana* or spreading and dilation, and
(5) *Gamanāgamana* or all motions in general.

(Refer to "Motion—*Parispanda*—Resolution of all physical action into motion," extracted from "The Positive Sciences of The Ancient Hindus" by B. N. Seal, in the appendix). Taken together, the term *karma* connotes different aspects of physico-chemical reactions viz., decomposition, dissociation, displacement, double-decomposition, substitution, hydrolysis, addition etc., including the products of physico-chemical changes, evolved as vapour or preciptated as insoluble substances, which are usually indicated in modern chemistry by arrows pointing upward ↑ and downward ↓ respectively.

It also connotes certain primary qualities of elemental substances—gaseous in nature in some cases, and solidity in others. In the case of some belonging to the latter category, their evaporability and sublimability under the influence of heat are implied.

In the context of *ūrdhvagāmi* and *adhogāmi*, the two actions or *karmās* assume importance viz., substances possessing the property of upward movement and downward movement respectively. We may illustrate the above ancient concepts with the following examples of modern chemistry :

Samyoga or combination reaction, e.g., the combination of chlorine and sodium to form sodium chloride.

$$2\ Na + Cl_2 = 2\ NaCl$$

Samyoga or *addition reaction* : As in the case of a molecule which combines as a whole with a compound, it is said to be added on or to form an ' addition product', e.g., etheyline and bromine, undergo an addition reaction.

$$C_2H_4 + Br_2 = C_2H_4Br_2$$

Samyoga or *substitution reaction* : As in the case of an element or compound which displaces another element from a compound and at the same time combines with the element displaced which is said to be substituted in the compound, e.g., methane and chlorine give methyl chloride and hydrogen chloride.

$$CH_4 + Cl_2 = CH_3Cl + HCl$$

Vibhāga or *decomposition reaction* : As in the case of a single substance which breaks into two or more simpler substances. This is stated to decompose, e.g., mercuric oxide when heated decomposes into mercury and oxygen.

$$2\ Hg0 = 2\ Hg + 0_2$$

Vibhāga or *dissociation reaction* : This reaction is almost the same as the decomposition reaction with this

difference that, it is applied to reversible reactions e.g., ammonium chloride dissociates when heated, into ammonia gas and hydrogen chloride, which on being cooled again recombine forming ammonium chloride.

$$NH_4Cl \rightleftharpoons NH_3 + HCl$$

Vibhāga or *displacement reaction*: As in the case of an element which reacts with a compound in such a way as to remove one element and itself combine with the reminder, e.g., zinc displaces copper from copper sulphate forming zinc sulphate and metallic copper.

$$Zn + CuSO_4 = ZnSO_4 + Cu$$

Vibhāga or *hydrolysis reaction*: As in the case of a compound which reacts with water in such a way that it splits up and forms two compounds, one with the hydrogen of the water and the other with the hydroxyl. This compound is stated to be hydrolysed.

$$AB + H.OH = AH + BOH$$

Another example of this reaction is thionyl chloride which is hydrolysed by water forming sulphurous acid and hydrochloric acid

$$O=S\begin{matrix}Cl\\Cl\end{matrix} + \begin{matrix}H\cdot OH\\H.OH\end{matrix} = O=S\begin{matrix}HO\\OH\end{matrix} + 2\,HCL$$

The case of certain reactions, the products of which move up i.e., *ūrdhvagāmi*, as in the case of vapour, or downward—*adhogāmi* i.e., precipitated as an insoluble substance, can be illustrated with the example of the equation:

$$Ca(HCO_3)_2 = CaCO_3 + H_2O + CO_2$$

Such reactions involve two of the five movements of *karma* viz·, *utkshepana* and *apakshepana*.

The property, *ūrdhvagāmitva* or *utkshepana* and *adhogāmitva* or *apkshepana*, with reference to the behaviour (in natural states) of some of the elemental substances can be illustrated as follows: [1]

Behaviour	Substance	Nature of Panchabhautic composition
Urdhvagāmi	Hydrogen	Ākāsa, Vāyu and Āpya
	Helium	Do
	Oxygen	Āgneya and Vāyavya
	Argon	Vāyavya
	Nitrogen	Vāyavya and Pārthiva
Adogāmi	Sodium	Pārthiva and Āgneya
	Potassium	Do
	Gold	Parthiva and Agneya,
	Silver	Do
	Copper	Do
	COMPOUNDS (ORGANIC)	
Urdhvagami	Alcohol	Āgneya and Vāyavya
	Chloroform	Do
	Ether	Do
	Petroleum	Āgneya, Vāyavya and Āpya
	Camphor	Āgneya and Vāyavya
Adogami	Proteins	Āpya, Pārthiva snd Agneya
	Carbohydrates	Do
	Fats	Do

1. The panchabhautic composition of the chemical elements described on basis of modern physical sciences as illustrated here is put forth by me. It represents at best, an attempt to classify the chemical elements and compound substances under the panchabhautic classification from known physical and chemical characteristics of these substances corresponding to those of the five bhutas.

Even though a third category viz., *ubhayagāmi* i.e., *gamanāgamana* does not appear to occur as such in the old medical classics, it is necessary to take note of some of the elemental and compound substances which move both ways under certain conditions. This variety can be illustrated as follows :

Behaviour	Substance	Nature of Pancha-Bhautic constitution	Remarks
Ubhayagāmi (gamanā-gamana)	Mercury	Apya, Pārthiva and Agneya	Sublimes under the influence of heat into vapour.
	Sulphur	Do	Do
	Arsenic	Do	Do
	Water	Apya and Vāyavya	Changed to –vapour under –the influence –of heat.

The condition under which *ūrdhvagāmitva* or *utkshepana* are manifested by substances which are primarily *adhogāmi* in nature, such as those mentioned above, is obviously the application of the required degree of heat from outside, when they sublime or vapourise as the case may be, and move upwards i.e., perform the act of *utkshepana*. This *karma* is potential or *anudbhūta* and *samavāya* in these substances. The reduction of temperature results in *adhogāmitva* or *apakshepana*. The factor which actualises the potential cause or *upādana kārana* is the *sahakāri* heat, which is the *nimitta kārana* i.e., the concomitant cause, which was not coinherent or '*samavāya*' in the substance.

Hence the *sahakāri* or heat in this case, is also known as *asamavāyi kārana*.

"Thus are described the *dravyās*." इति द्रव्यम् ।

The concepts of virya and vipāka

The concepts of *virya*, *vipāka* and *prabhāva* among others, have been esteemed as some of the valuable features of *Āyurveda*. Next perhaps to the *panchabhūta* theory of Matter and the *tridosha* theory of physiology and pathology, the pharmacological and therapeutical concepts of *virya*, *vipāka* and *prabhāva* have been the bone of contention among the most learned and erudite of scholars and *vaidyās* in the present as in the past. Till now the mode of approach for a proper elucidation of these, as of other concepts of *Ayurveda*, has been the use of *vyākarana*, *tarka*, or *vādas* and *vākyārtha* on platforms. It is obviously because of this tendency prevalent in his times, *Vāchaspati Misra* was constrained to note that the lovers of *tarka*, often seek to perceive even perceptible things by inferance.

प्रत्यक्षपरिकलितमपि अनुमानेन बुभुत्सन्ते तर्करसिकाः ।
(Vāchaspati Misra)

This mode of approach to the elucidation of scientific concepts, which have considerable practical value and utility, is possibly a misfit to afford an intelligible and demonstrable orientation to them. These are directly related to bio-physical and bio-chemical events. For, it can be seen from facts relating to these concepts available in the authoritative ancient works on *Ayurveda* as well as in the natural philosophies, such as the *Nyāya*

Vaiseshika and *Sāmkhya Yoga* systems, as well as some of the important commentaries on them and on which *Ayurveda* has largely relied, that they relate to and deal with physico-chemical reactions or *pākās* to which the *ahāra* or food and *aushadha* or medicinal substances are subjected, in the *amāsaya-pakvāsaya* (gastro-intestinal tract) during the process of digestion, and in the *dhātūs* (or tissues) all over the body, during the metabolic processes. These processes comprise of highly complex chemical reactions or *visesha-pākās* involving the play of different kinds of enzymes, co-enzymes, harmones, oxygen etc., at every stage and in every step, which together, are spoken of as *vijāthiya tejas*.

The real value of the concepts of *virya* and *vipāka*, as of other related concepts referred to above, lies in the actual application of them in practice for the determination and prediction of the effects and fate of food and medicinal substances in *swasthāvasta* or physiological and *aswasthāvasta* or pathological states.

While endless debates on and discussions of these concepts have been going on year after year, organized and systematic efforts do not appear to have so far been made even to verify and determine the actions of *ahāra* and *aushadha dravyās* mentioned in the ancient texts, leave alone the question of the determination and demonstration (experimentally and clinically) of the actions of substances as have not been mentioned in the ancient books, on the basis of these concepts. There is, however, sufficient evidence in the authoritative classics themselves to emphasise the importance and utility of these principles to justify a proper evaluation of them

now, in the light of facts of the modern science. At any rate, these principles cannot be dismissed off-hand as antiquated, empirical, out-dated and out-moded methods of explaining the properties and actions of articles of food and medicinal substances on living organisms.

The obvious method for resolving these problems is to make a fresh approach to them on the lines suggested by Albert Einstein, "*to regard old problems from new angle.*" In the words of Einstein : "To raise new questions, new possibilities, *to regard old problems from new angle* (italics mine) requires creative imagination and mark real advance in science."[1] The elucidation of the old concepts of *virya* and *vipāka* now offered is the outcome of an approach, not only "*to regard old problems from new angle*" *but also to regard new facts of modern science from an old angle.* The facts and conclusions presented here are meant to stimulate discussion and continued research on similar lines.

Virya

The term *virya* means power, potency and efficacy.[2] It also conveys the meaning 'manliness', and 'valour'. In the context of *Āyurveda*, however, this term conveys the idea of Energy.[3]

A reference was already made to *virya* in pages 42-43 of section I of this book. It was then seen that *virya* is of two kinds viz., *ushna* or hot and *sita* or cold.

1. Einstein : "The Evolution of Physics", Cambridge University Publication, 138 Edn. p. 95.
2. Samskrit English Dictionary by Arthur A Macdonell.
3. Samskrit English Dictionaries by Monier Williams & Apte.

उष्णशीतगुणोत्कर्षात्तिव वीर्यं द्विधा स्मृतम् ।

The definition of virya : The term *virya* has been defined by *Charaka* " as the power that performs work. All actions take place only because of *virya*. There is no action which is not due to *virya* "

.....वीर्यं तु क्रियते येन या क्रिया ।
नावीर्यं कुरुते किंचित् सर्वा वीर्यकृता क्रिया ॥
(Charaka ; Sutra 26: 64)

With this definition, all the other ancient authorities are agreed. But *Susruta*, *Vāgbhata* and their followers are not agreed with the views of *Charaka* and his followers that the term *virya* can be applied to the eight primary qualities of elementary substances viz., *mrudu* ; *tikshna* ; *guru* ; *laghu* ; *snigdha* ; *rūksha* ; *ushna* and *sita*.[1] This is evident from the observation of *Vāgbhata* that :

वीर्यं पुनर्वदन्त्येके गुरुस्निग्धहिमंमृदु ॥
लघुरूक्षोष्णं च तदेवं मतमष्टधा ।

Charaka and his followers have sought to justify their stand on the ground that " the eight *gunās* are the essence of the rest i.e., the twenty *gunās*[2] which are extremely potent in their action. These *gunās* are also important in the description of the actions of *dravyās* (as compared to the actions of *rasās* etc.,) because, the natural tastes of substances can (easily) be changed (or

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1. मृदुर्नातिष्णगुरुर्लघुस्निग्धरूक्षोष्णशीतलम् ।
वीर्यमष्टविधं केचित्.....॥ (Charaka ; Sutra 26: 65)

2. गुरुमन्दहिमस्निग्धश्लक्ष्णसान्द्रमृदुस्थिराः ।
गुणाः स सूक्ष्मविशदा विंशतिः सविपर्ययाः ॥
(Ash. Hri. Sutra ; Ch. I ; 18)

modified) by combining them variously. On the contrary, the primary physical qualities of (elementary) substances viz., the eight *gunās* remain constant and cannot, therefore, be changed (or modified). Hence they are accorded priority of consideration in all descriptions (of substances). Therefore, the eight *gunās* are classed as *viryās.*"

गुर्वादिष्वेव वीर्याख्या तेनान्वर्थेन वर्ण्यते ॥
समग्रगुणसारेषु शक्त्युत्कर्षविवर्तिषु ।
व्यवहाराय मुख्यत्वद्द्रव्याग्रग्रहणादपि ॥

On the other hand, *Susruta*, *Vāgbhata* and their followers have firmly affirmed that there are only two *viryās* :

उष्णं शीतं द्विधैवान्ये वीर्यमाचक्षते ।

Says *Vāgbhata* quoting *Susruta*: "Even though the universe presents itself in great diversity and heterogeneity, still it is composed of two kinds of things only viz., those that are invisible or *avyakta* and others as are visible or *vyakta*. Likewise, although *dravyās* appear to be diverse in nature, still they are never divorced from the two powerful and potent *gunās*—'*agni*' and '*shoma.*'[1]

अपि च ।

नानात्मकमपि द्रव्यमग्निषोमौ महाबलौ ॥
व्यक्ताव्यक्तं जगदिव नातिक्रमति जातुचित् ।

The terms '*agni*' and '*shoma*' are usually rendered as *ushna* or hot and *sita* or cold. This way of rendering these terms do neither appear to be exact and correct

1. तच्च वीर्यं द्विधामुष्णं च अग्निषोमत्वाज्जगतः ।
(Susruta)

nor do they bring out the full implications and significance of them to *vignāna* or science.

The terms viz., '*agni*' and '*shoma*' are *Upanishadic* in origin and usage. '*Shoma*' is also spoken of as '*annam*' (अन्नम्), the later term being interpreted as 'the things of the universe which are utillised for existence– अद्यते अत्ति च भूतानि तस्मादन्नं तदुच्यते । (Taitreya)

In other words, the terms '*shoma* or *annam*' represent the Matter of the universe which allows itself to be demposed or disintegrated or cooked. Likewise, the term '*agni*' which is also spoken of as '*prāna*', is that which disintegrates, decomposes or cooks (*Shankarāchārya*).

'*Shoma*' and '*agni*' are stated to be inseparable. They are linked together inseparably (मिथुनं उत्पादयत्) This co-existence is spoken of as '*rayi*' (रयि). These two terms have been interpreted to connote Matter and Energy which are never separated from each other. All things in the universe represent two aspects of nature viz., Matter and Energy in the state of '*mithuna*'.

We may perhaps agree with the views of *Susruta* the surgeon which is supported by *Vāgbhata*, who dismisses the long-drawn controversy over the *gunās* and *viryās* in which great deal of logic and dialectics have been employed, with the observation: "No amount of logic will alter the nature of things nor persuade the drugs belonging to the *ambashtādi gana* to exercise purgative action," and adopt the view that there are and can be only two *viryās viz.*, *ushna* and *sita*. This, we shall do, not only because they have been

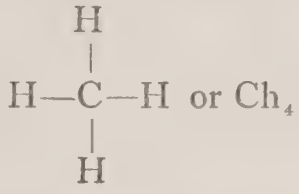
expressed by great authorities on *Ayurveda* but also on a proper examination of this subject in the light of reasoning on scientific lines.

The existence of a striking resemblance between the ancient *Ayurvedic* and the more recent modern definition of Energy was discussed in brief while we were on this topic in the first section. To recapitulate: the modern definition of Energy is that "the energy of a body is its capacity for doing work; the measure of energy is work; when chemical change takes place energy is liberated or absorbed, usually as heat but occasionally as light, electricity or work. In reactions where energy change is not great, all the energy appears as heat, unless a gas is formed, when its evolution does work against the pressure of the atmosphere. A reaction which liberates heat energy is said to be *exothermic* and one which absorbes heat energy is said to be *endothermic*."[1]

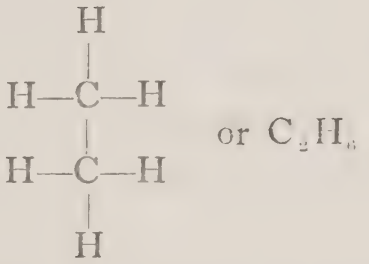
Energy may be kinetic or potential. The Energy locked up in substances e.g. food, is known as the 'chemical potential Energy.' Animal life is not possible without this Energy and it represents the force or power which makes it possible for atoms to combine in a firm union with one another to form molecules. In other words, there exists between atoms a bond or affinity. Some atoms like hydrogen, chlorine, sodium, and potassium have only one bond. Others have two or more. Since oxygen has two affinities, it can unite with two hydrogen atoms yielding one molecule of water. Unlike the chemical atoms instanced above,

1. Sherwood Taylor, "Inorganic and Theoretical Chemistry," p. 27; 1939 Edn.

the element carbon has four affinities. Its atoms are, therefore, considerd to be superior to others, not only on account of their affinity to each one of the species to combine with those of its kind, but also with other kinds of atoms. This unique feature of carbon is usually illustrated with the example of methane and ethane. The former represents one carbon atom which has combined with four atoms of hydrogen as shown below:



The later i. e., ethane gas represents the combination of two carbon atoms with six of hydrogen, as shown below :



An example of the combination of one atom of carbon with two of oxygen can be represented as follows :

The bond that holds the atoms in a molecule is the Energy which is latent or is potentially held in the compound. This Energy is released for work by oxidation, when it is known as Kinetic Energy.

In so far as food substances are concerned, the chemical potential Energy locked up in the melecules of carbohydrates, fats and proteins, are released during the catabolic process. This may be illustrated with the example of carbohydrates. When glucose which is $C_6H_{12}O_6$ is oxidised in the tissues, the chemical potential Energy is released for the performance of work. This is represented as follows:

$$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6H_2O + \text{Energy}$$

On the other hand, the process of repair and rebuilding of the body machinery known as anabolism, involving the synthesis of simple substances into the complex substances of the protoplasm, is one of the locking up of the chemical potenial Energy. Both the processes, the catabolic involving *vibhāga* and anabolic involving *samyoga*, take place under the influence of enzymes and oxygen, which are essentially *āgneya* in constitution. In the case of the former process, these substances serve as the *nimitta kārana* and the resulting release of Energy is known, in the language of the *Sāmkhya* system, as *udbhūta vritti sakti.* In the case of the latter process, on the other hand, specific enzymes direct the process of synthesis or *samyoga*, leading to the storing of the chemical potential Energy in the tissues. The latent or chemical potential Energy is known as *anudbhūta vritti.* "The material cause or the sum of material causes," it was seen in our study of the *Sāmkhya* system, "is the only power which is efficient in the production or rather in being the vehicle of power. This power is the unmanifested or potential form of Energy set free-*udbhūta vritti*

sakti –in the effect." [1] In the reverse direction, the latent or the (chemical) potential Energy, it was seen, is known as "*anudbhūta vritti*."

The mention made of the influence of *nimitta kārana* in the foregoing paragraph, refers to the transformation of Energy from one form to another, due to *pāka karmās* in the *dhātūs* or tissues. The term *pāka-karma* comprehends on the one hand, (a) the breaking of complex substances into their simpler components i.e., molecules or *pitharās;* the breaking of the particular alignment of *pilūs* or atoms composing the molecules i.e., *pitharās*, thus releasing the locked up Energy in the process ; and (b) the reformation of *pitharās* once again with *pilūs* in different other patterns or modes of alignment and the building up of complex substances with *pitharās*, on the other. The breakdown reactions and the reactions leading to synthesis, involving the release and the locking up of Energy respectively, are together known as *pākabhedās.* The predominantly *thaijasika* or *āgneya* type of substances which direct and accelerate the one or the other of the reactions referred to above, are known as *vijātiya tejas.*[2]

Energy transformations which take place during the process of life have been described as *ushna* and *sita viryās. Dravyās* or substances to which *ushna virya* is ascribed, are those that promote or undergo *vibhāga* or catabolic reactions (cleavage, disintegration, decomposition, dissociation, hydrolysis etc.) On the other hand

1. The Fundamental Principles of Ayurveda, by the author, Part II, p. 55.

2. Refer to the description of Pilu and Pithara paka and the foot notes thereto in pages 41-47 of Part I of the Fundamental Principles of Ayurveda, Outlines of Nyaya Vaiseshika system of Natural Philosophy, by the author.

dravyās or substances which have been stated to be *sita* in *virya* are those that promote or undergo anabolic reactions and changes respectively, resulting in the conservation of Energy in a potential form. An example of a substance possessing *sita virya* is stated to be milk.

The conclusions stated in the foregoing paragraphs are based on the rationalistic orientation given to the term *virya* in the *Ayurveda Rasāyana* commentary on *Ashtānga Hridaya* extracted here under :

वीर्यद्वैविध्यमाह—उष्णेति | तच्च उष्णं शीतं च ननु गुरुलघुस्निग्धरूक्षमन्द-तीक्ष्णानामपि वीर्यत्वात्कथं द्वे एवेत्यत आह—उष्णशीतगुणोत्कर्षात्, यद्यपि कायाग्नि-पाकादष्टौ गुणा जायन्ते, तथाप्युष्णशीतयोर्गुणयोरुत्कर्षात् द्वैविध्यम् | गुणान्तरतिरस्कारे शक्तिरुत्कर्षः | शक्त्युत्कर्षे वीर्यशब्दो लोकेऽपि प्रसिद्धः | तत्र द्रव्ये वीर्यमपि द्रव्याश्रय-मित्यर्थः ||

"Although the eight *gunās* of *dravyās* become actualised in the process of their *pāka* by *kāyāgni*, they (the *gunās*) are ultimately transformed to *ushna* and *sita*, due to the greater exaltation of these two *gunās* (i. e., *ushna* and *sita*) which obscure or supercede the other *gunās*. This is spoken of as *utkarsham*. It is well known in the world that these two *gunās* are spoken of as *viryās* at the time when their *sakti* or power is actualized and rendered active. The *dravya* is the substrate of *virya* which is of two kinds viz., *ushna* and *sita*."

That the process of Energy transformation described as *virya*, takes place in food substances from the time they (the food substances) enter the body and continue to be in it, and also that such transformations take place as the result of various kinds of chemical reactions in

the tissues - *pākabhedās* in *dhātūs* –which are described in terms of *vipāka*, can be seen from the observation of Charaka that :

रसे निपाते द्रव्याणां विपाकः कर्मनिष्ठया ।
वीर्यं यावधीवासान्निपाताच्चोपलभ्यते ॥

"The taste of a substance is felt at the commencement only i.e., when the substance comes in contact with the tongue, and the post-digestive changes are felt only when the final effects of digestion are produced, while *virya* is observed throughout the stay of the substance in the body, begining from its first entry into it (the body)."

Virya—sahaja and kritrima

According to *Sivadāsa*, *virya* can be *sahaja* or natural and *krtrima* or artificial.[1] The former has been illustrated with the example of *māsha* whose natural *virya* is *sita*, *guna guru*, and *rasa* and *vipāka madhura*. *Mudga* is *ushna* in *virya*, *laghu* in *guna*, *madhura* in *rasa*, and alternatively, *katu* and *amla* in *vipāka*. *Lāja* obtained by frying rice, is an example of a substance whose *virya* has been *rendered* artificially into *ushna*, *laghu* in *guna*, *madhura* in *rasa*, and alternatively *katu* and *amla* in *vipaka*, as is evidenced in *karma nishta*. Milk is an example of a substance which in nature is *guru* in *guna*, *madhura* in *rasa* and *vipāka*, and *sita* in *virya*. When soured, it is rendered as *laghu* in *guna*, *amla* in *rasa*, and alternatively *amla* and *katu* in *vipāka* and *ushna* in *virya*. The former state illustrates the natural *virya* of milk and the latter the *kritrima*.

1. Sivadasa, quoted in the foot note to chapter 26 of Charaka Samhita, page 148 (Nirnayasagara Press Publication, 1941 edition).

एतच्च वीर्यं सहजं कृत्रिमं च ज्ञेयम् । तत्राद्यं मापाणां गौरवं मुद्गानां लाघवमित्यादि ; कृत्रिमं तु लाजादीनां लघुत्वमित्यर्थः ॥

That the description of the process of conversion or transformation of the natural *viryās* and *gunās* of substances bears a close resemblance to the preparation, in modern times, of predigested foods, can be seen from the observation of *Charaka* that ;

गुरूणां लाघवं विद्यात् संस्कारात् सविपर्ययम् ।
व्रीहेर्लाजा यथा च स्युः सक्तूनां सिद्धिपिण्डकाः ॥
(Charaka: Sutra ; 27 ; 339

"The heavy articles, it should be known are rendered light by proper treatment and the light ones can likewise be rendered heavy, just as rice becomes light when roasted, and roasted corn flour becomes heavy when prepared into balls and cooked."

The properties of ushna virya

Ushna virya produces *bhrama* or giddiness (vertigo); *thrit* or thirst ; *glāni* or bodily exhaustion, and fatigue, *sweda* or sweating; *dāha* or inflammatory reactions, and *āsupākita* or accelerated biochemical reactions or digestion. It alleviates *vāta* and is *kaphahara*."

तत्रोष्णं भ्रमतृट्ग्लानिस्वेददाहाशुपाकिताः ।
शमनं च वातकफयोः..... ॥

The properties of sita virya

Sita virya, on the other hand, causes *hlādana* or cheerfulness and pleasure of mind ; *jivana* i. e., sustains life; *sthambhana* or imparts strength, sturdiness and steadiness to the body, and cleanses *rakta* and *pitta*.

.....शिशिरं पुनः ।
ह्लादनं जीवनं स्तम्भं प्रसादं रक्तपित्तयोः ॥

Summing up: The term *virya*, in the context of life process implies Energy and its transformation from one state to another viz., kinetic to potential and *vice versa*. *Ushna virya* represents kinetic Energy derived from food substances in biochemical reactions. The potential chemical Energy derived from food substances when stored or locked up in the tissues, either as part of their structure or as reserve fuel depot to meet the Energy needs of the organism as occasion demands, represents *sita virya*. From the point of view of the *Sāmkhya* system, the former state of Matter is known as *udbhūta vritti sakti* and the latter as *anudbhūta vritti*. Stated in brief and in modern scientific parlance, the concept of *virya* of *Āyurveda* in its two main aspects represents Energy transformations to which food substances are subjected, during the process of life.

Vipāka

Vipāka, as in the case of other qualities of substances, such as *rasa*, *guna*, *virya* and *prabhāva* is not, it is obvious, a primary quality. As in the case of other secondary qualities noted above, *vipāka* also arises out of the various modes of combinations and permutations of the elemental substances, and the molecules formed with them in compound substances. In other words, the *samyoga*, *vibhāga* and *parispanda* of the elementary substances and the molecules arising out of their combination have much to do in the manifestation of the

several secondary qualities ascribed to compound substances. It should not be forgotten that the process of *samyoga* implies the locking up of Energy which becomes potential or *anudbhūta* in the substances arising out of the reaction. *Vibhāga* implies the release of the binding Energy which may be utilized in the performance of the particular kind of *karma* or activity, or it may be dissipated in the form of heat, together with other by products of the reaction. In both cases, there is the exhibition of heat or *agni–endo* or *exothermic*. In other words, these reactions imply *pākabhedās* or different kinds of chemical reactions.

This aspect of the phenomenon depends on *agni*. The concept of *agni* was sought to be clarified in pages 20-22. It was pointed out there that the terms *koshtāgni* and *jathrāgni* connoted various kinds of digestive juices which split the different complex organic components of food substances into their simpler forms, thus rendering them fit for absorption. By the same token, it was shown that the terms *dhātwagni* or *kāyāgni* stood for various cellular enzymes, harmones and oxygen, which act on the end-products of gastro-intestinal digestion brought to the tissues by the blood, or in other words, metabolic reactions viz., catabolic and anabolic. If the *pāka* (*pachana*) in the *amāsaya–pakvāsaya* (gastro-intestinal digestion) involves a mere break–down of complex food substances into their simpler components, the *pāka-karma* or the bio-chemical reactions that take place in the *dhātūs* or tissues all over the body involve both non-oxidative (anaerobic) and oxidative (aerobic) reactions, implying *samyoga* and *vibhāga*.

The interpretation of the term *agni* as above, is not only based on the properties ascribed to it in the ancient classics on *Ayurveda* [1] but also on other authoritative non-medical works. For example, the definition and description of *tejas* or *agni* furnished by the *Tarka Samgraha* is extremely reliable and illuminating. According to this work, the substance *tejas* or *agni* possesses the property of heat, as could be cognized by tactile perception. It occurs in two forms viz.,

(i) *Nitya* or permanent (indestructible) and (ii) *anitya* or transient. The former is atomic (or corpuscular) in nature, whereas the latter is understood in effect or *kārya.* [2] The *anitya* or the transient type occurs in three forms viz., (a) *Tejas sarira* or the physical form of the *tejas* is well known in *Sūrya loka* or the solar system; (b) *Indriya tejas* or the sensory form of *tejas* is to be seen as a point within the black of the eye (pupil). It makes visual perception possible[3] , and (c)

1. .....तत्र पक्वामाशयमध्यगम् ।
पञ्चभूतात्मकत्वेऽपि यत्तैजसगुणोदयात् ॥
त्यक्तद्रवत्वं पाकादिकर्मणाऽनलशब्दितम् ।
पचत्यन्नं विभजते सारकिट्टौ पृथक् तथा ॥
तत्रस्थमेव पित्तानां शेषाणामप्यनुग्रहम् ।
करोति बलदानेन पाचकं नाम तत् स्मृतम् ॥
(Ash. Hr ; Sutra 12; 10-12)

2. Light, according to modern views, has dual properties viz., particles or corpuscules and waves. Whenever it hits us, whenever it enters our eyes, burns our skin or takes a photograph, then light is stated to behave like particles. It is in its act of getting to us, and in particular, the quantity of it that gets to us, that it is stated to behave as waves. Apparently, therefore, the particle or corpuscle represents the nitya type of tejas. The waves of it arise as the karya or effect when it is active. It is in this aspect that the anitya or transient form of tejas is to be understood.

3. This form of *tejas* is termed as the alochaka pittha in Ayurveda which corresponds to the description of the visual purple of the retina.

the *Vishyatejas* or the *tejas* that occurs as the objects of the senses. This variety is of four kinds viz., (i) the *Bhoumatejas*, or the *agni* of the earth, such as the fire etc., [1] ; (ii) *Divyatejas* or the *tejas* of the sky, such as the lightning, rays of the sun, moon and stars [2] ; (iii) *Audarya tejas* or the *tejas* that occurs in the gastro-intestinal secretions which are responsible for the execution of the digestion of foods and drinks ; and (iv) *Ākarajatejas* or the *tejas* present in the metals dug from mines, such as gold, silver etc. [3] We are concerned here with the *audarya tejas*, which according to the *Nyaya Bodhini*, is secreted in the gastro-intestinal tract. The gastro-intestinal juices are called *agni* because they consume food like fire and produce heat in the body.[4] This allusion may be extended to apply to *kayāgni* or *dhātvagni* i.e., the cellular enzymes also which direct, execute and control various kinds of biochemical reactions involved in metabolic processes.

These *pāka-bhedās* which effect physical and chemical changes, as the case may be, in the food or medicinal substances in the living organism, are spoken of as

1. Oxygen is a form of *Bhouma tejas*. So also is the case with the phosphorescence of the glow-worm.
2. Electro-magnetic and stellar emanations.
3. Radio-active metals and minerals.
4. Notes on *Tarka Samgraha of Annambhatta*, by Athalye p. 112 (1930 Edn.)

उष्णस्पर्शवत्तेजः । तच्च द्विविधम्, नित्यमनित्यं च । नित्यं परमाणुरूपम् । अनित्यं कार्यरूपम् । पुनस्त्रिविधं शरीरेन्द्रियविषयभेदात् । शरीरमादित्यलोके प्रसिद्धम् । इन्द्रियं रूपग्राहकं चक्षुः तच्च कृष्णतारागवर्ति । विषयश्चतुर्विधो भौमदिव्योदर्याकरजभेदात् । भौमं वह्न्यादिकम् । अभिन्धनं दिव्यं विद्युदादि । भुक्तस्य परिणामहेतुरुदर्यम् । आकरजं सुवर्णादि ॥

(Tarka Samgraha)

pithara pāka and *pilu pāka* respectively. In the language or *Ayurveda*, the break-down of complex substances into their simpler components without involving any major chemical change in their composition, is known as *avasthāpāka*, and the metabolic changes to which the simpler products of gastro-intestinal digestion are subjected to in the tissues (*dhātūs*), is known as ***nishtā-pāka.***[1]

If this much is properly understood, then, the full significance and implications of the concept of *vipāka* will become very clear and can be intelligently appreciated.

It is now necessary to recapitulate the description of *vipāka* to which a reference was made in the first section viz.,

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1. Charaka makes a direct and significant reference to metabolic transformations which articles of food and drink undergo in the dhatus or tissues all over the body, resulting in the building of the body elements, the development of energy and heat as follows :

विविधमशितं पीतं लीढं खादितं जन्तोर्हितमन्तरग्निसन्धुक्षितबलेन यथा स्वेनोष्मणा सम्यग्विपच्यमानं कालवदनवस्थितसर्वधातुपाकमनुपहतसर्वधातूष्ममारुतस्रोतः केवलं शरीरमुपचयबलवर्णसुखायुषा योजयति शरीरधातूनूर्जयति च। धातवो हि धात्वाहाराः प्रकृतिमनुवर्तन्ते ॥

(Charaka ; Sutra 28, 3)

"The different varieties of valuable nutritient substances consumed by man, viz , eatables, drinks, electuaries and masticables on being digested by the heat (*ushna*) of the particular body element (*dhatus*) concerned, whose strength is kept active by the internal fire (अन्तराग्नि), imbue the entire body wherein metabolic processes of all the body elements (धातुपाक) are constantly going on like the (inexorable) process of time (काल) and wherein, the circulation of the body elements and the body channels is unimpeded, with growth, strength, complexion, happiness and life, as well us replenish the body elements. It is by being nourished with corresponding elements that the body elements are able to maintain the body in the normal condition."

"The *rasās* of substances ingested being acted upon by *jātharāgni* in the small intestines, are changed to different other tastes after attaining *pakva*. It is this transformation of *rasās* that is spoken of as *vipāka*."

जाठरेणाग्निना योगाद्यदुदेति रसान्तरम् ।
रसानां परिणामान्ते स विपाक इति स्मृतः ॥

"Stated in general, *madhura* (sweet) and *lavana* (saline) change over to *madhura* (sweet) after reaching the small intestines; *amla* (sour or acid) attains *pakva* as *amla* (sour or acid), and *tikta* (bitter), *katu* (pungent or acrid) and *kashāya* (astringent), change over to *katu* (pungent or acrid). The *rasās* attained as a result of *vipāka* act in the same manner as *rasās* (in general).

स्वादुः पटुश्च मधुरमम्लोऽम्लं पच्यते रसः ।
तिक्तोषणकषायाणां विपाकः प्रायशः कटुः ॥

It is necessary in this connection, to take note of the use of the term '*prāyasah*' in the *sūtra* referred to above. It means 'generally' and conveys the idea that the change of the original *rasās* at the end of the gastro-intestinal digestion to different other *rasās* need not take place as a rule and in all cases. This has a special reference to *tikta*, *kashāya* and *katu*.

There are also different other views held about the *vipākās*. Some hold that there are as many *vipākās* as there are *rasās*. Others, especially *Susruta*, held that there are and there can only be two *vipākās* namely, sweet or *madhura* and acrid or *katu*. "The former" says *Susruta* "is *guru* or heavy and the latter *laghu* or light."

आगमे हि द्विधा एव विपाको मधुरः कटुश्च ।
तयोर्मधुराख्यो गुरुः कटुकाख्यो लघुरिति ॥
(Susruta ; Sutra 4: 10)

Elaborating this view, he states that the primary qualities or properties that characterise the five kinds of elementary substances i.e., *bhūtas* (viz., *prithvi*, *ap*, *tejas*, *vāyu*. and *ākāsa*) may be described as *gurutva* and *laghutva*, which are fundamental. The former characterises food substances, which in digestion, are seen to assume *madhuratva* (sweetness) and *gurutva* (heaviness), while the latter which posses the primary properties of *vāyu*, *tejas* and *ākāsa* are known as substances of light digestion or are easily digertables.

द्रव्येषु पच्यमानेषु येष्वम्बुपृथिवीगुणाः ॥
निवर्तन्तेऽधिकास्तत्र पाके मधुर उच्यते।
तेजोऽनिलाकाशगुणाः पच्यमानेषु येषु तु ॥
निर्वर्तन्तेऽधिकास्तत्र पाकः कटुक उच्यते ।

(Ibid 12)

As an empirical proposition, the above description of *vipāka* of *Susruta* is of considerable significance and has the merit of simplicity. We shall examine this view in the light of modern facts at a later stage.

A proper understanding and appreciation of the concept of *vipāka* will be made easier by taking note of a few more important ancient contributions to this topic. *Chakrāpani Datta*, an authoritative commentator of *Charaka Samhita*, commenting on the observation of *Charaka* viz.,

रसो निपाते द्रव्याणां, विपाकः कर्मनिष्टया ।
वीर्यं यावधीर्यासान्निपाताच्योपलभ्यते ॥

(Ch, Sut. 26: 66)

"The *rasa* or taste of a substance is perceived at the commencement only (i.e. when the substance contacts the tongue). The effects of *vipāka*, on the other hand, i.e.,

the transformation or changes in the taste of substances that manifest towards the end of their digestion in the gastro-intestinal tract, are to be seen only when the final effects of digestion are produced," notes निपात इति रसनयोग i.e., the discharge of taste (impulses) arise on account of the contact of materials with the tongue; निपातात्चेति शरीरसंयोगमात्रम् i.e., the taste perception (or the discharge of taste impulses), can arise only when materials come in contact with *sarira* or the living and functioning body (and not otherwise). Yet another significant observation of *Charaka* which has to be noted to help us to clinch the issue of *vipāka* is the mutual relationship that exists between *vipaka* and *virya*. He says :

शीतवीर्येण यद्द्रव्यं मधुरं रसपाकयोः ।
तयोरम्लं यदुष्णं च यद्द्रव्यं कटुकं तयोः ॥

(Ibid 25, 45.)

A substance which is sweet in taste i.e., in *rasa* and *vipaka*, is *sita* in *virya*. That which is *amla* in taste and *vipāka* is *ushna* in *virya*. Similarly, that which is *katu* in taste and *vipaka*, is *ushna* in *virya*".

In view of the ancient *Ayurvedic* observations cited above, the question will now arise as to what exactly is the meaning, significance and implications of the term *vipaka*. The term *pāka*, it was seen, corresponds to physico-chemical reactions and changes. *Vipaka* on *visesha* or *visishta-paka* will convey the idea of special kinds of chemical reactions. A reference was already made to the *avasthāpāka* i.e., chemical reactions which result in the physical change of the food sub-

stances ingested, and to *nishtāpāka* i.e., reactions which involve both *vibhāga* and *samyoga*, comparable to reversible reactions, comprehending dissociations, additions and synthesis at the level of the atoms that compose molecules of various kinds in the tissues, and the reformation of new molecules.

It is highly interesting to note that:

(1) according to *Susruta*, the final products of gastro-intetinal digestion yield substances, some of which taste sweet and others acrid. This view does not, however, provide for the possibility of substances which may result in *amla* or acid reactions.

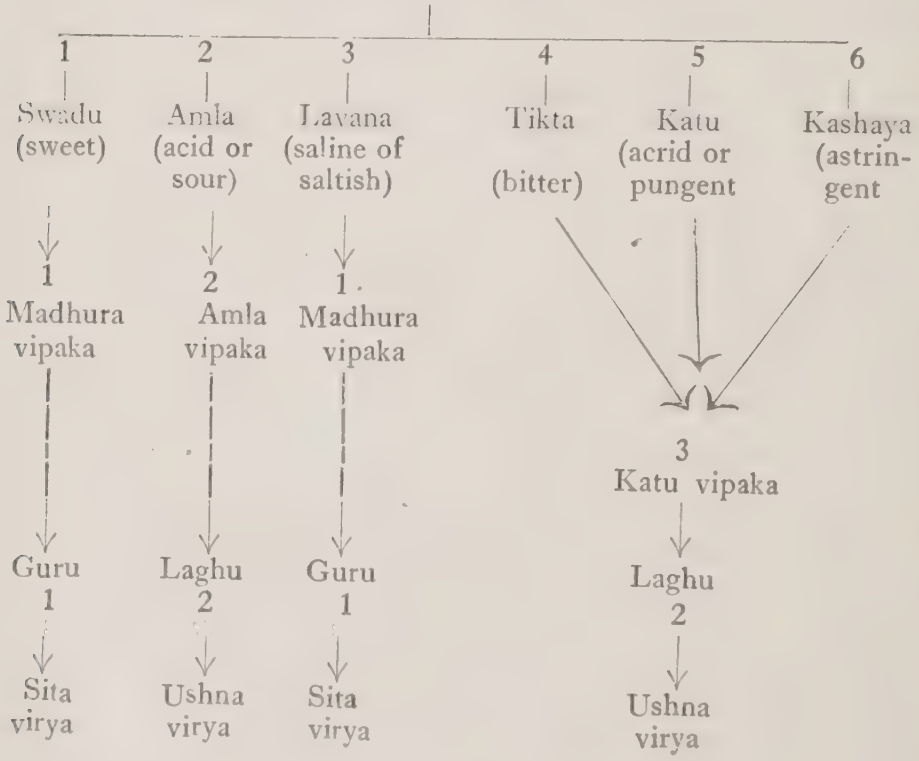
(2) According to both *Charaka* and *Vāgbhata* the ultimate products of gastro-intestinal digestion are stated to yield substances which not only attain sweet and acrid tastes, but also sour or acid as well.

(3) According to *Susruta*, substances which attain sweet or *madhura vipāka* are generally heavy i.e., *guru* and those that attain acrid or *katu vipāka* are *laghu*. Stated in terms of their *panchabhautic* constitution, the former is primarily *pārthiva* and *āpya* in constitution, whereas the latter is predominantly *ākāsa*, *vāyu* and *tejas* in structure.

(4) The statement of *Charaka* that the taste of substances become manifest in the tongue only and their *vipāka*, described in terms of

rasa or taste, is to be understood from the effects ascribed generally to *rasās* in systemic reactions. These effects, it is stated, are to be judged in terms of the *virya* of the final product. *Dravyās* which undergo *madhura vipāka* are stated to be *sita* in *virya*, and the effects they produce ultimately are those which are ascribed to this *virya*. The schema furnished below will make it easy to understand at a glance the (scientific) value of the concept of *vipāka* as described by the three outstanding authorities of *Ayurveda* *Charaka*, *Susruta* and *Vāgbhata*.

AHARA AND AUSHADA DRAVYAS UNDERSTOOD IN TERMS OF THEIR RASĀS



To sum up:

The term *vipāka* has a direct reference to the metabolism of food materials and the pharmacology of medicinal drugs. In the former case, it comprehends various digestive and metabolic sequences and the biochemical reactions involved in them, as may be judged from the taste of the end-products of anabolic and catabolic reactions. The final products of anabolic reactions represent the potential energy stored up as fat in the adipose tissue, glycogen in the liver and muscles, and the amino acids in the tissues. Of the latter (i) leucin, (ii) d-tryptophane, (iii) phenylalanin, (iv) glycols, (v) glycine and (vi) sarcasine in particular, are built up in the protoplasm of the tissues of the body. The quality of the nutrient substances anabolised as above are stated to be *guru* or heavy; their *virya* or power *sita* or cool, and *vipaka* described in terms of *rasa* or taste, as *madhura* or sweet.

On the other hand, catabolic or Energy releasing reactions of these substances, involve a number of changes, comprehending hydrolysis, dehydration, reversible reactions and oxidation—all involving changes in the taste of sugars, fats and proteins, at every stage and in every step, viz.,

$$\text{Sweet} \rightarrow \text{Sour} \rightleftharpoons \text{Acrid} + n(O_2) \rightarrow \text{Energy} + 2CO_2 + 2H_2O$$

These Energy transformations can be described in terms of work performed and the heat conserved and dissipated. Described in terms of the concept of *vipaka*, all

substances possessing *madhura rasa*, loose their *pārthiva* and *āpya* constituents in catabolic reactions and therefore, their *gurutva* and *madhura rasa* attain *laghutva* and alternatively *amla* and *katu rasās*. According to *Āyurveda*, substances tasting *amla* and *katu rasās* are constituted predominantly with *tejas* and *prithvi* and *tejas* and *vāyu* respectively. In quality they are *laghu* and *ushna* in *virya*. The final outcome of these reactions is the Energy made available for work, the heat conserved and dissipated and the waste products or *malās* released in the process, as may be seen in the schema presented here.

Amla rasa and amla vipāka

Substances tasting sour or *amla* are acids. Their constitution, as already noted, is predominantly *tejas* and *prithvi*. These substances comprise of organic and mineral acids. The examples of the former are the acetic acid in vinegar, citric acid in oranges and lemons, malic acid in apples and fatty acids in the butter milk. The examples of the latter are the hydrochloric and nitric acids. A feature common to all acids is to ionise in aquous solution into an anion and cation, of which the latter is always the hydrogen-ion. The greater the concentration of hydrogen–ion in a pure solution, the stronger is its acid character and the more pronounced is its sour taste. In other words, strong acids are very highly ionised i.e., most of the molecules have dissolved into ions. Weak acids, such as those of vegetable origin, on the other hand, are not highly ionised and their solutions, therefore, contain comparatively large number of molecules from which ions have not dissociated. It will, hence be seen, that the sour taste is

generally proportional to the concentration of hydrogen-ions.

With this brief summary of the nature of substances which taste sour, it may be stated that their *vipāka*, during the process of digestion (*avasthāpāka*) and metabolism (*nishtāpāka*) is stated to be *amla*. A careful study of the changes which take place in substances tasting sweet—the carbohydrates, fats and proteins-when called upon to yield Energy will show that they reach the pyruvic acid stage, from whence, they are turned to acetaldehyde, which after oxidation yields acetic acid and the latter again is oxidised to yield Energy, heat, 2 CO_2 and 2 H_2O. Except in the case of acetaldehyde which is acrid or *katu* in taste, the pyruvic and acetic acids are weak acids tasting sour. It will be seen from the above that not only mineral acids but also the orgrnic acids represent the tastes of intermediary products in the process of Energy production. Stated in terms of *Ayurveda*, these acidic substances which are predominantly *taijasika* and *pārthiva* in constitution are *laghu* in *guna*, *amla* in *rasa* and *vipāka* (*avastha* and *nishtāpākās*), *ushna* in *virya*, or in other words, anabolic changes invariably result in the production of substances which are *madhura*, both in respect of their *rasa* and *vipāka*, *sita* in *virya* and *guru* in *guna*. Such substances generally result in *brimhana*. In contrast, catabolic events result invariably in the production of substances which are predominantly *taijasika* and *pārthiva* in constitution, *laghu* in *guna*, *amla* in *rasa* and *vipāka* and *ushua* in *virya*. Such substances usually produce *karsana* or distrophy.

The *vipāka* of substances that taste *lavana* or saltish, *tikta* or bitter and *kashāya* or astringent, as well as the pharmacological aspects of *vipāka* will be dealt with separately in a subsequent publication.

THE RELATIVE ACTIONS OF RASA, VIRYA AND VIPĀKA

It was noted that the physiological and pharmcological actions of nutritional and medicinal substances or *dravyās* depend on their *rasa*, *virya* and *vipāka* and that each one of these qualities produce distinct and specific actions.

Āchārya Vāgbhata states that substances-nutritional and medicinal—exert their influence-beneficial or otherwise—due to the one or the other of their qualities stated below:

1. The action of some substances are due to their *rasa* only ;
2. ,, ,, *vipāka* only ;
3. ,, ,, other qualities (*gunās*) in them;
4. ,, ,, *virya* only ;
5. ,, ,, *Prabhāva* only.

The *ācharya* qualifies the above by stating that, of the several qualities viz., *rasa*, *guna*, *virya*, *vipaka* and *prabhāva*, the *dravya* acts by virtue of the particular quality which is more dominant than the rest or in otherwords, the more prominant and dominant quality superceeds the rest :

रसैरसौ तुल्यफलस्तत्र द्रव्यं शुभाशुभम् ।
किञ्चिद्रसेन कुरुते कर्म पाकेन चापरम् ॥
गुणान्तरेण वीर्येण प्रभावेणैव किञ्चन ।
यद्यद्द्रव्यम् रसादीनां बलवत्त्वेन वर्तते ॥

Mutually conflicting qualities and *actions of substances*: "Substances in which," says *Vāgbhata*, "mutually conflicting and incompatible qualities co-exist, in such cases, the numerically homologous among them combine to counteract the action or powers of the less active qualities."

अभिभूयेतरांस्तत्तत्कारणत्वं प्रपद्यते ।
विरुद्धगुणसंयोगे भूयसाऽल्पं हि जायते ॥

This concept has been illustrated as follows : milk is stated to possess *sitavirya*. As such, it should vitiate *vāta*. But because milk also possesses *madhurarasa*, *snigdha* and *guru gunās* which alleviate *vāta*, these qualities which put together are numerically stronger, suppress or supercede the *anti-vātic* action of milk.

The assessment of the value of substances in which all the five properties are of equal strength

Where *rasa*, *guna*, *virya*, *vipāka* and *prabhāva* of a substance are of equal power and strength, in such cases, the *vipāka* may supersede the actions ascribed to both *rasa; virya* may supersede the actions of both *rasa* and *vipāka*, and *prabhāva* may supersede the actions ascribed to *virya*. This is stated to be due to the innate nature of substances, in such cases.

रसं विपाकस्तौ वीर्यं प्रभावस्तान्यपोहति ।
बलसाम्ये रसादीनामिति नैसर्गिकं बलम् ॥

The concepts referred to above have been illustrated as follows :

(a) Honey is sweet in taste. (The sweetness of it is due to its monosaccharide content). But the sweet taste of honey is stated to attain *katu vipāka* (in *nishtā-pāka*). Therefore, this substance, instead of alleviating *vāta* due to its predominantly sweet taste, is stated to provoke this *dosha* on account of its *katu vipāka*.

(b) Even though the flesh of the buffalo is sweet, both in *rasa* and *vipāka*, the actions ascribed to these two qualities are superseded by its *virya* which is *ushna*. Hence, this kind of flesh, instead of alleviating *pitta* on account of its *madhurasa* and *vipāka*, is stated to provoke this *dosha*.

(c) In spite of the fact the alcoholic beverage known as *sura* is *amla*, both in *rasa* and *vipāka*, and *ushna* in *virya*, it promotes the secretion of milk which possess qualities antogonistic to those of the flesh of the buffalo. This action is ascribed to *prabhāva*, which is stated to supersede the powers of other equally powerful qualities possessed by buffalows' flesh. (After *Aruna Dattā's Sarvāngasundara* commentary).

Prabhāva

Prabhāva hes been defined as the special property of a substance which produces actions different from and contrary to those ascribed to *rasa*, *guna*, *virya* and *vipāka*.

रसादिसाम्ये यत् कर्म विशिष्टं तत् प्रभावजम् ।

This property represents the characteristic and specific actions of substances which cannot be explained in terms of the pharmacological actions of their various individnal constituent principles taken out separately.

The concept of *prabhāva* has been illustrated with the following examples :

(i) The *rasa, guna, virya* and *vipāka* of *nebāla* or croton and *chitramūla* being apparently identical, the former produces purgation, whereas the latter does not produce this action.

(ii) Similar is also the case with *drāksha* and *atimadhura*.

(iii) While ghee promotes *jatharāgni*, milk on the other hand, inhibits it and makes it dull.

दन्ती रसाद्यैस्तुल्याऽपि चित्रकस्य विरेचनी ।
मधुकस्य मृद्वीका घृतं क्षीरस्य दीपनम् ॥

The definition and description, as well as the examples cited to illustrate the concept of *prabhāva* appears to generally resemble the concept of isomerism and isomerides of modern physical chemistry. According to the this concept, substances may possess identity of chemical composition and yet exhibit different properties. The cases of urea $CO<^{NH_2}_{NH_2}$ and ammonium cyanate NH_4CNO can be cited as examples of isomerides. Both these compounds have the same molecular formula N_2H_4CO and yet, they are different in their properties. The same is also the case with ethyl ether, $(C_2H_5)_2O$ and butyl alcohol C_4H_9OH. From these, it will be seen that the chemical composition which largely determines the secondary qualities of substances, such as *rasa, guna virya* and *vipāka* of substances does not, therefore, uniquely determine a chemical compound. The examples of 'isomerides' effectively illustarate the concept of *prabhāva*.

Vichitra Pratyayārabdhā

So far, the secondary qualities of substances, viz., *rasa, virya, vipāka* and *prabhāva* have been considered. It has to be noted in addition , that these actions may also be modified by various factors according to the nature of *dravyās*. Such substances are classified under the concept of *vichitrapratyayārabdha.*

इति सामान्यतः कर्म द्रव्यादीनां पुनश्च तत् ॥
विचित्रप्रत्ययारब्धद्रव्यभेदेन भिद्यते ।

In this connection, it is necessary to note that *dravyās* are classified under two heads, viz.,

i. *Samāna pratyayārabdhā*: Ordinarily the *bhūtās* or elemental substances which contribute to the constitution of *rasa, virya, vipāka* etc., also contribute to the composition of substances which are the substrate of them. These substances are usually classed under the head *samāna pratyayārabdhā.* The qualities and actions of such substances are determined and actualised according to their secondary qualities, such as the *rasa, virya* and the rest. Examples of this category of substances are as follows: substances which possess *madhurarasa* and *guru guna* are by nature *anti-vātic, sita virya* and *madhura vipāka.* Accordingly, it is but natural for *godhūma* which possesses' these qualities to be *anti-vātic*; milk *sita-virya* and the flesh of the swine *madhura vipāka.* These three examples illustrate here the substances classified under the category *samāna-prtyayārabdha* which act by virtue of their *rasa, guna, virya* and *vipāka.*

ii. *Vichitra pratyayārabdha*: In substances belonging to this category, the collocations of the molecules

responsible for the determination of their characteristic *rasa*, *guna*, *vipāka* and *virya* are of an order different from those of the *bhūtās* or elemental substances which collocate to constitute these molecules. It is because of this structural peculiarity that the effects produced by these substances are at variance with those ascribed to the different secondary qualities mentioned above.

The increase of *vāta* caused by substances which are *madhura* in *rasa* and *guru* in *guna* but undergo *katu-vipāka* and exhibit *ushna-virya*, are actions out of the normal. Likewise, the provocation of *vāta* by the use of *yava* i.e., barley, the *ushna virya* of fish, the *katu vipāka* of lion's flesh, are due to *vichitra pratyayārabdha of* these substances.

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APPENDIX

I

Chemical Action and Heat

(Extracted from the Positive Sciences of the Ancient Hindus, by Prof. B. N. Seal, M.A., Ph.D)

The operation of heat is of course universally implied in chemical combinations. Where the application of external heat is wanting, Vatsyayana, the great doctor of the Nyaya, points to the of the operation of internal heat (e.g. पृथिवीधातुः अब्धातुना संगृहीतः आन्तरेण तेजसा पच्यमानः रसद्रव्यं निर्वर्तयति ।–Vatsyayana–Bhashya, IV. Ahnika 1, Sutra 47). In the case of combustion we have seen Vignana bhikshu explain the heat as latent in the Earth substance, the fuel, from which it breaks forth. Udayana points out that the solar heat is the source of all the stores of heat required for chemical change in the world. The change of colours in grasses, for example, is due to Tejas in the form of latent (invisible) heat, not in the form of Agni; and the cold in winter cannot take away this store derived from the sun. (तृणादिविकारो हि यदि रूपादि-परावृत्तिमात्रहेतुः स नूनमौष्ण्यापेक्षेण तेजसा कर्तव्यः । तादृशे च पाके अग्निमित्तं हिममिति । न किञ्चिदनिष्टमापद्यते । न हि सौरस्य तेजसः त्रैलोक्यपाकहेतोर्हिमादपगमः क्षमते । अथ विकारो भस्मादिरूपो विवक्षितः सोऽसिद्ध एव हिमहेतौ तृणादिषु क्व विरोधो बाधो वा । अथ रूपादिपरावृत्तिमात्रेणैव अग्निः साध्यते तदशक्यम् । तस्य दर्शनस्पर्शनग्राह्यस्य योग्यानुपलम्भबाधितत्वात् अतादृशस्य तेजोमात्रस्य निवृत्तेरशक्यत्वात् अनिष्टत्वात् च ।—Udayana, Kiranaval. सृष्टिसंहारविधिनिरूपणम् ।)

Similarly it is under this solar heat that the unripe mango ripens, i.e., changes colour, taste, smell, etc., showing that there is chemical transformation or subtile

decomposition and recomposition going on; and this is also the case with the rusting of the metals, which is a combustion due to the solar heat (सूर्यपाक) even as the conversion of food into chyle and of chyle into blood are instances of chemical action due to the internal animal heat (जठरानिल or औदर्य तेजः). But the kind of contact with heat-corpuscles, in other words, the kind of chemical action (पाक) which transforms colours, is supposed to differ from that which transforms flavour (विलक्षणतेजः संयोग and पाक), and this last from that which produces a change of smell, or tactile quality. (पाको नाम विजातीयतेजःसंयोगः | स च नानाजातीयः । रूपजनको विजातीयतेजःसंयोगस्तदपेक्षया रसजनको विजातीयः । एवं स्पर्शादौ अपि तथा | एवंप्रकारेण भिन्नभिन्नजातीयाः पाकाः कार्य्यवैलक्षण्येन कल्पनीयाः । तथा हि तृणपुञ्जनिक्षिप्ताऽमादौ उष्णलक्षणविजातीयतेजःसंयोगात् पूर्वहरितरूपनाशरूपान्तरस्य पीतादेरुत्पत्तिः पूर्वरसस्य अम्लस्यैवानुभवात् । क्वचित् पूर्वहरितरूपसत्त्वेऽपि रसपरावृत्तिर्दृश्यते विजातीयतेजःसंयोगरूपपाकवशात् पूर्वतनाम्लरसनाशे मधुररसस्यानुभवात् | तस्माद्रूपजनकापेक्षया रसजनको विलक्षणः एवं गन्धजनको विलक्षण एवाङ्गीकार्यः । रूपरसयोरपरावृत्तौ अपि पूर्वगन्धनाशे विजातीयपाकवशात् सुरभिगन्धोपलब्धेः । एवं स्पर्शजनकोऽपि पाकवशात् कठिनस्पर्शनाशे मृदुस्पर्शानुभवात् । अत एव पार्थिवपरमाणूनामेकजातीयत्वेऽपि पाकमहिम्ना विजातीयद्रव्यान्तरानुभवः । यथा गोभुक्ततृणादीनां आपरमाण्वन्तं भङ्गे तृणारम्भकपरमाणुषु विजातीयतेजःसंयोगशात् पूर्वरूपादिचतुष्टयनाशे तदनन्तरं दुग्धे यादृशं रूपादिकं वर्तते तादृशरूपरसगन्धस्पर्शजनकास्तेजःसंयोगा जायन्ते । तदुत्तरं तादृशरूपादय उपद्यन्ते । तादृशरूपादिविशिष्टपरमाणुभिर्दुग्धद्व्यणुकमारभ्यते । ततः द्व्यणुकादिक्रमेण महादुग्धारम्भ इति ।—Nyayabodhini on Annam Bhatta's Tarkasangraha.)

Heat and light-rays are supposed to consist of indefinitely small particles which dart forth or radiate in all directions rectilineally with a sort of conical dispersion and with inconceivable velocity. They may either (1) penetrate through inter-atomic (or inter-molecular)

spaces as in cases of conduction of heat, which when applied under the pot boils the water or fries the paddy, where there is no chemical action in the pot, no decomposition and recomposition of its atoms, no change in the molecular collocation ; or, as with light-rays in cases of translucency or transparency (स्वच्छता), penetrate through the inter-atomic spaces with Parispanda of the nature of deflection or refraction (तिर्य्यग्गमन, Udyotakara), in the same way as when fluids penetrate through porous bodies (तत्र परिस्पन्दः तिर्य्यग्गमनं परिस्रवः पात इति Udyotakara, commenting on Vatsyayana's परिस्पन्दपरिस्रवौ Sutra 47, Ahnika 1, Chap. III) ; or (2) impinge on the atoms, and rebound back—which explains reflection (मूर्च्छन, किरणविघट्टन Varahamihira, रश्मिपरावर्तन Vatsyayana), or otherwise be obstructed by the atoms in their path, which would explain degrees of opacity, the casting of shadows, etc., all these operations being also physical, and unattended by decomposition and recomposition or alteration of molecular grouping ; or (3) lastly, strike the atoms in a peculiar way, so as to break up their grouping, transform the physico-chemical characters of the atoms, and again recombine them, all by means of continual impact with inconceivable velocity, an operation which explains all cases of chemical combination. (अचिन्त्यो हि तेजसो लाघवातिशयेन वेगातिशयः यत् प्राचीनाचलचूडावलम्बिनि एव भगवति मयूखमालिनि भवनोदरेषु आलोक इत्यभिमानो लौकिकानाम्— Udayana Kiranavali, तेजोनिरूपणम् taken from Vachaspati, Tatparya tika प्रत्यक्षलक्षणसूत्रम् *Cf.* also चाक्षुषं तेजः वेगवता सावित्रेन तेजसा न प्रतिहन्यते।— Vachaspati.)

वर्त्तिदशं पिण्डितमपि तेजः प्रसर्पत् प्रासादोदरं व्याप्नोति। तत् कस्य हेतोः पृथग्द्रव्यात्। स्वभावतः प्रसरदपि न स्वपरिमाणानुविधायिनं प्रत्ययमाधत्ते किं तु

विषयभेदानुविधायिनम् । Ibid. *Cf.* स्फटिकाद्यन्तरितोपलब्धिरपि प्रासादस्वभावतय स्फटिकादीनां तेजोगतेरप्रतिबन्धकतया प्रदीपप्रभावादेवोपपन्ना । Udyana. तेजो निरूपणम्, in reply to the objection: यदि हि प्राप्य गृह्णीयात्प्रतिघातिन स्फटिकद्रव्येण विष्टम्भादप्राप्तं प्रसर्पत्तृणादिकं नाददीत तस्मादप्राप्यकारि ततो न तैजसम् Udayana, Ibid. Definition of स्वच्छता–द्रव्यान्तरासम्भृक्तद्रव्यसमवाय स्वच्छता दृष्टश्चाप्रतिघातः काचाभ्रपटलस्फटिकान्तरितोपलब्धः । ..... स्याल्यादि च पाचकस्य तेजसा अप्रतिघातात्—Udyotkara, Chap. III, Ahnika 1 Sutra 38.

आदित्यरश्मेः स्फटिकान्तरितेऽपि दाह्येऽविघातात् । Sutra 47, where Udyotakra notes :

कोऽयमविघातः–यस्य द्रव्यस्यावयवा न व्यूह्यन्ते तस्य अन्तरावयवैः अव्यूह्य मानस्य योऽभिसम्बन्धः सोऽविघात इति ।

Vachaspati explains यस्य द्रव्यस्य भर्जनकपालादेः अवयवा न व्यूह्यन्ते पूर्वोत्पन्नद्रव्यारम्भसंयोगनाशेन द्रव्यान्तरजनकसंयोगोत्पादनं व्यूहनं तत् क्रियन्ते तस्य द्रव्यस्य भर्जनकपालादेरव्यूह्यमानस्य अन्तरावयवैर्योऽभिसम्बन्धो वह्नेः सोऽप्रतिघातः ।

Cf. Vatsyayana on Sutra 47, Ahnika 1, Chap. III On the other hand, in chemical combination अन्तःप्रवेशः कृशानोरनुमीयते । तेन वेगवता वह्निद्रव्येण नोदनात् अभिघातात् वा अवयवेषु क्रिया, क्रियातो विभागः, विभागात् आरम्भकसंयोगविनाशः etc., Jayanta, Manjari, भूतचैतन्यपूर्वपक्षः ।

For opacity, shadows, etc. vide च्छाया तु तेजःपरमाणोरावरणात् मूर्तिमता परमाणुना तेजःपरमाणुराक्रियते । यत्र च अस्य आवरणं तत्र च्छायेति । विरलतेजःसम्बन्धीनि द्रव्यगुणकर्माणि च्छाया इत्यभिधीयते । सर्वतो व्यावृत्ततेजः-सम्बन्धीनि तु तानि तमःसंज्ञकानि । — Udyotakara, Chap. IV., Ahnika 2, Sutra 25. For reflection and its laws, I quote passages in my Paper on Hindu Physics, to which the student of the history of Optics is referred).

II

Parispanda—Resolution of all Physical Action into motion

Parispanda sometimes stands for motion, molar as well as molecular, but more often for the subtile motion of atoms or molecules. The radical meaning of the term is whirling or rotary motion, a circling motion, but it may also include simple harmonic motion (e.g. vibration). All action, operation, work (क्रिया, व्यापार) is ultimately traced to this form of subtile motion lodged in the atoms or in the matter-stuff. The Vedanta, for example, speaks of a cosmic vibratory motion (सर्वलोकपरिस्पन्दनम् —Sankara). Akasa, in the Vedanta, as we have seen, is the first stadium in the evolution of Matter, which gives off Vayu, which gives off Tejas, and so on; but Akasa (ether) itself passes through two stages before the emanation of the Sukshma bhuta Vayu; (1) the motionless ubiquitous primordial matter-stuff (answering to the Sankhya Bhutadi) called Puranam Kham (पुराणं खं); and (2) a subtile integration, the pure un-quintuplicated Sukshma Bhuta called Vayuram Kham (वायुरं खं), answering to the Sankhya Tanmatra stage. It is this subtile Akasa, in its Tanmatric integration, i.e., in the derivative form, which is subject to an incessant Parispanda. The gaseous stage of matter (the Vedantic Vayu) is indeed matter in a state of Parispandic motion (वायोः परिस्पन्दात्मकत्वात्—Sankara). So also the biomotor and sensori-motor principles apart from the directive intelligence of the Self (प्राणस्य परिस्पन्दात्मकत्वादेव यद्द्वैतम् स्थूलं सूक्ष्मञ्च तत् सर्वं मनःस्पन्दितमात्रम्——Sankara). The Sankhya also

conceives this Parispanda to characterise every proces and phenomenon of cosmic evolution (व्यक्तं सक्रियं परिस्पन्दवत्- Vachaspati, Kaumudi). Bhutas, organisms, menta organs, as modes or Prakriti (considered apart from the Intelligence or Purusha) are all subject to thi Parispanda (बुद्ध्यादयो देहं त्यजन्ते देहान्तरं उपाददते इति तेषां परिस्पन्दः शरीरबुध्यादीनां च परिस्पन्दः प्रसिद्ध एव।—Vachaspati on Karika 10)

On the other hand, Prakriti as the Avyakta, the a-cosmic, the un-manifest ground, with resolution only of like to like (सदृशपरिणाम), is devoid of all Parispandic motion (यद्यपि अव्यक्तस्यापि परिणामलक्षणा क्रिया, तथापि परिस्पन्दो नास्ति —ibid. on Karika 10).

The Nyaya-Vaisesika finds Parispanda in all forms of matter, except Akasa, which in that system is non-atomic and incapable of any change or activity (निष्क्रिया). But all atoms, from those of Vayu downwards, are in incessant motion. The world at bottom is an infinitude of continually whirling (or vibratory) particles (अनवरत-परिस्पन्दमानापरिमितपवनादिपरमाणवः— Raghunatha; compare also Udayana-Kusumanjali, Stavaka V. — परमाणवः दिगनिशीलत्वात् पतत्रव्यपदेशाः पतन्तीति ।)

All physical action consists in motion. The Nyaya-vaisesika rejects force, operation (शक्ति) except as modes of motion. Jayanta, indeed, states : We do not acknowledge any mysterious power or operation which the senses do not and cannot report to us. But this denial of Force (शक्ति) and of unperceived and unperceivable operation (अतीन्द्रियव्यापार) is put forward as a philosophical (epistemological and metaphysical) proposition to justify the Nyaya analysis of the causal *nexus* into

mere invariable and unconditional antecedence among phenomena without productive power of efficiency (अनन्यथासिद्धनियतपूर्ववर्तिता —Bhasha Parichcheda). It is not, of coarse, intended to question the existence of Parispanda, which is of the nature of motion, and which, though subtile and therefore infra-sensible सूक्ष्म and not अतीन्द्रिय), is the ultimate form of all physical activity. परिस्पन्द एव भौतिको व्यापारः करोत्यर्थः । अतीन्द्रियस्तु व्यापारः नास्तीति ब्रूमहे ।....तस्मात् कारकचक्रेण चलता जन्यते फलम् । न पुनश्चलनादन्यो व्यापार उपलभ्यते । Jayanta, Nyayamanjari, Ahnika 1).

The effect (no less than the action), is, in all cases of material causation, the resultant of the combined motions of the various (material and efficient) causes involved (e g. in the case of पाक, समुदिततण्डुलसलिलादिसकलकारकनिकरपरिस्पन्द एव विशिष्टफलावच्छिन्नः पाक इत्युच्यते । .... अथ व्यापार एवैषः सर्वः संभूय साध्यते । किं फलेनापराद्धं वः तद्धि संभूय साध्यताम् । — Jayanta, Nyayamanjari, Ahnika 1.)

But, in the Nyaya-Vaisesika, though all action of matter on matter is thus resolved into motion, conscious activity is sharply distinguished from all forms of motion, as against the Sankhya-Vedanta, which, as we have seen, considered everything other than Intelligence–the Purusha or the transcendental Self,—to arise in the course of cosmic evolution, and therefore to be subject to Parispandic motion (क्रियाविशेष एवायं व्यापारो ज्ञातुरान्तरः । स्पन्दात्मककर्त्रादिभूतक्रियालक्षणविलक्षणः । Quoted in Jayanta's Nyayamanjari, Ahnika 4).

MECHANICS (KINETICS)
Analysis of Motion

In his Bhasya on the Vaisesika Aphorisms, written probably on the third or fourth century of the Christian

era, if not earlier, Prasastapada begins the Section on Motion (कर्मग्रन्थ) with the definition of Karma (motion lit. work) as the unconditional cause of conjunction and disjunction, i.e. of change of place in a particle (संयोगविभागनिरपेक्षकारणम्). He regards *Karma* (motion) as instantaneous (क्षणिक) in its simplest form, distinguishing it from *Vega* (impressed motion, momentum), which is a persistent tendency, Sanskara, and implies a series of motions. Accordingly in one and the same particle there can be only one motion (karma) at any given moment, since its change of place at that moment is one and definite (एकदा एकस्मिन् द्रव्ये एकमेव कर्म वर्तते।–Prasastapada Bhashya, Karma Padarta Nirupana). The supposition of two (instantaneous) motions in the same particle is superfluous. They may be so opposed as to neutralise each other, in which case, the particle would be at rest. If they are not so opposed, and motion (i.e., an instantaneous change of place) follows, then, since this change of place is a definite change, one motion would be sufficient to account for it, and the hypothesis of two motions would be meaningless (अथ अविरुद्धकर्मद्वयसमावेशः तदा एकस्मादेव उपपत्तेः द्वितीयकल्पनावैयर्थ्यम्। Prasastapada). One and the same motion can effect only one particle, as the changes of place of different particles must be different (एकं कर्म न अनेकत्र वर्तते— ibid.)

Now motion is always marked by a certain direction (दिग्विशिष्टकार्यारम्भकत्वमस्य विशेषः):

(i) The successive motions of a particle may be in the same direction (rectilinear), e.g. (a) upward or downward vertical motion, as in throwing upwards or downwards in the case of objects moved by volition

directly or indirectly (उत्क्षेपणं, अपक्षेपणं), or (b) other forms of rectilinear motion, contraction, dilation (आकुञ्चनं, प्रसारणं), or

(ii) the directions of the successive motions may be different, as in curvilinear motion यदा नियतदिक्प्रदेशसंयोग-विभागकारणं तद्गमनम्) e.g. भ्रमण (rotatory motion), स्पन्दन (vibratory motion), etc. All these are varieties of Gamana गमन, curvilinear motion.) उत्क्षेपणादिशब्दैः अनवरुद्धानां भ्रमणपतनस्पन्दनादीनां अवरोधार्थं गमनग्रहणं कृतम्। *Cf* Sankara Misra, गमनत्वं च जातिविशेषः भ्रमणरेचनस्पन्दनोर्ध्वज्वलननमनोन्नमनादिष्वपि.

In another sense, all kinds of motion in material (inanimate) objects, whether rectilinear or curvilinear, are called (Gamana) (गमन).

एतत् पञ्चविधमपि कर्म शरीरावयवेषु च तत् सम्बद्धेषु तत् प्रत्ययं असत् प्रत्ययं च यत् अन्यत् अप्रत्ययमेव तेषु अन्येषु च तत् गमनमिति.

Single particles, then, may have a serial motion. When particles (अवयवाः) combine to form a body (अवयवी) they may move continuously in a straight line, in which case the body is said to move in that direction (अवयविक्रियाया यावदवयवक्रियानियतत्वात् the action of a composite whole is determined by the action of the constituent parts taken together). But different particles may move in different directions, or again, the particles may have a curvilinear motion, and in such cases it appears as if different motions are impressed on the body, e.g. the falling leaf driven by the wind may have a rotatory or vibratory motion (भ्रमण, स्पन्दन) and a vertical downward motion (पतन) at the same time. Here each particle of the leaf taken separately has only one motion or change of place at the same moment, but

from the point of view of the observer द्वय, the particles have a rotatory or vibratory motion in one relation, and the leaf as a whole has a downward motion in another relation. The motion at any instant is really one, but for convenience of analysis we consider the rotatory change of place as separate from the change of place in the downward direction :

एकस्मिन् कमणि युगपत् द्रष्टृणां भ्रमणपतनप्रवेशनप्रत्ययाः कथ भवन्ति ? अत्र ब्रूम अवयवावयविनो दिग्विशिष्टसंयोगविभागानां भेदात् ।—(Ibid)

MOTION CONSIDERED IN RELATION TO ITS CAUSES

Various kinds of motion are observed :—

I. Movements which are not caused by contact with matter :—

(1) Movements caused by volition (प्रयत्न), e.g. the movement of the hand.

(2) Movement as of a falling body. This is caused by gravity (गुरुत्व), which in the astronomical treatises of Aryabhata, Brahmagupta, and Bhaskara is ascribed to the attraction (आकर्षण, pulling force) exercised by the earth on a material body. The force of gravity may be counter-acted by volition (विधारकप्रयत्न) as in holding up the hand, or by contact, as when a body rests on a support, or by Vega (वेग), impressed motion, as in the flying arrow which is kept from falling by the motion impressed on it.

(3) Motion of fluids, as the downward flow in a stream (स्यन्दन). This is due to fluidity (द्रवत्व), which is a characteristic property of certain kinds of atoms, in some cases original, in others produced by the contact of these atoms with the atomic porticles of heat (e.g. in the fire). But Sankara Misra points out that this property, fluidity, is only a concomitant condition (असमवायि-

कारण); the efficient cause (निमित्तकारण) is even in this case gravity (गुरुत्व) in the particles of the fluid. यत् दूरसंसरणं स्यन्दनं तत् द्रवत्वात् असमवायिकारणात् उत्पद्यते, गुरुत्वात् निमित्तकारणात् असमवायिकारणेषु। (Sankara Misra, Upaskara, on Sutra 4, Ahnika 2, Chap. V., of the Vaisesika Sutras).

(4) Certain motions, not due to material contact, of which the mechanical causes are unknown, and which may be ascribed to the universal final cause, Adrista (अदृष्ट), e g., the first motion in atoms at the beginning of Creation, the upward motion of fiery particles or atoms, and the oblique motion of gaseous particles, Vayu (वायु), the movement of iron towards the magnet, capillary motion (अभिसर्पण) as of liquid particles from the root to the stem of a plant. The upward motions (आरोहण) of water particles in evaporation and in boiling do not require the hypothesis of Adrista, as these are caused by the pressure of heat-corpuscles (तेजः परमाणु) and the contact with air-particles (नोदनापीडनात् संयुक्तसंयोगाच्च। Vaisesika Sutra, Chap. V. Ahnika 2.)

Meaning of Adrista

Adrista (lit. unseen) stands for 'unknown cause' or 'unexplained Nature' in the earlier Vaisesika writers. Several classes of cases falling under Adrista are distinguished, e.g.—

(1) The operation of merit and demerit (धर्म and अधर्म), a transcendental cause, which has to be posited in explaining the conjunctions and disjunctions of souls with their organic vehicles (bodies), which cannot be ascribed to natural causes, but presuppose the law of Karma or the operation of moral causation, as super-imposed on the natural order.

(2) Various kinds of motion in the different classes of elements, e.g. their natural modes of operation such as the dispersion of Vayu (air, gas), the upward motion of fire, the attraction of the needle by the magnet, etc., motions which serve the ends of Creation and of created beings (उपकारकं, अपकारकं). Such natural properties must be ascribed to Adrista, final causality (उपकारापकारसमर्थं अदृष्टकारितं) provided the *cause cannot be ascertained by observation or inference.*

1. लब्धवृत्तिभ्यां धर्माधर्माभ्यां कर्मोत्पद्यते– Ibid
अपसर्पणकर्म उपसर्पणकर्म

2. एवमन्यदपि महाभूतेषु यत्प्रत्यक्षानुमानाभ्यामनुपलभ्यमानकारणं उपकारापकारसमर्थं च भवति तदपि अदृष्टकारितं–Ibid.

Jayanta in the Nyaya-Manjari notes that Adrista is resorted to in explanation of observed phenomena only when these cannot be derived in any way from the operation of known cause—

यदि अदृष्टमन्तरेण दृष्टं न सिध्यति काममदृष्टं कल्प्यताम् अन्यथा अपि तु तदुपपत्तौ किं तदुपकल्पनेन दृष्टिसिद्धये हि अदृष्टकल्प्यत्वं न तु दृष्टविघाताय । (न्याय-मञ्जरी । Ahnika 1).

Similarly, Jayanta notes that, when anything is put down as natural (स्वाभाविक), we may mean either that it has no cause or no uniform cause, or no known cause. Of these the first two alternatives must always be dismissed and 'natural' can only mean something of which the cause has not yet been ascertained (स्वाभाविकं नाम किमुच्यते किमहेतुकं अविज्ञातहेतुकं अनियतहेतुकं वा । न तावदहेतुकं कार्यं सम्भवति..... ...नापि अनियतहेतुकं कार्यं किञ्चिदस्ति (न्यायमञ्जरी- चार्वाक मतनिरास ।)

This sound interpretation of Adrista was afterwards obscured. In modern writers of the Nyaya-Vaiseshika school, physical and mechanical ideas have suffered a set-back, and even the formation of the hail-stone is ascribed to the operation of moral causes (धर्माधर्म).

II. We come now to motions produced by contact (संयोग). Such motions may be classed as follows, according to the nature of the contact originating them :—

(1) Motion due to direct contact with a body exercising continued pressure (नोदन), e.g. the motion of an object pushed or pulled by the hand, the motion of the mud under heavy stones, the motion of the arrow due to the pressure exercised by the bow-string, the motion of the bow-string due to the pressure of the elastic bow as it recovers its original shape, the motion of clouds, of volumes of dust, of balloons, sailing vessels and other vehicles under the impelling force (pressure, नोदन, प्रेरण) of the wind, etc. वायुर्मेघादिप्रेरणधारणादिसमर्थः Prasastapada, वायुनिरूपण--मेघादीत्यादिपदेन यानपोतादिपरिग्रहस्तेषामपि वायुना प्रेर्यमाणत्वात् । (Sridhara) मेघादीति आदिग्रहणात् वैहायसानां विमानादीनां (baloons in the sky) भौमादीनां च पानपात्रपांशुपटलादीनां जलानलयोश्च परिग्रहः (Udayana, Kiranavali वायुनिरूपणम्)

N. B.—Udayana makes a similar reference to balloons filled with gas or smoke (धूमापूरितचर्मपुटकम्) in discussing the opinion that air has weight (Kiranavali, वायुनिरूपणम्). These passages show that balloons were known in Udayana's time (970 A.D.—vide उदयन Lakshanavali).

(2) Motion due to direct contact for an instant with a body that strikes and produces an impact (अभिघात),

e.g. in the cases of a stone falling against a hard object (पाषाणादिषु निष्ठुरे वस्तुनि अभिपतितेषु—Sridhara), the potter's rod striking the wheel, the mortar struck against the pestle. Instantaneous disjunction is necessary to impact. If there is continued contact, the result is pressure (नोदन). In some cases there may be disjunction (i.e. a rebound) after continued pressure यत्र अभिघातकं द्रव्यं भूप्रदेशं अभिहत्य किञ्चिदधो नीत्वा उत्पतति—श्रीधरन्यायकन्दली).

(3) Motion due to direct contact with an elastic body which exercises a moving force by means of its elasticity (स्थितिस्थापकत्व) in the act of restitution of the original form (यथास्थितं स्थापयति) e.g. the motion of the bow-string due to the force exercised by the piece of bamboo (the bent bow). This force of restitution in an elastic body is a kind of Sanskara i.e. persistent tendency (धनुःशाखाशृङ्गदन्तास्थिसूत्रवस्त्रादिषु भूम्नसंवर्त्तितेषु, स्थितिस्थापकत्वकार्यं संलक्ष्यते—Prasatapada Bhasya–bows, twigs, tooth-bones, horn, thread, cloth, etc., are noted as elastic).

(4) Motion due to contact with a body which is itself in contact with another which possesses Vega (impressed motion or momentum) (वेगवद्द्रव्यसंयुक्त-संयोग). This is the fact of the transmission of pressure or moving force, and the consequent production or communication of motion, as for example, in the pulling of an object by means of a string, the pushing of the potter's wheel by the potter's rod, etc.

Cause of Motion or Force

Force is of the following kinds :—

1. Continued pressure (नोदन)
2. Impact (अभिघात)

3. Persistent tendency (संस्कार), of which there are two kinds :—(a) Vega (वेग impressed motion, momentum), the persistent tendency to motion in a moving body, and (b) the tendency to restitution of shape in an elastic body (स्थितिस्थापकसंस्कार).

N.B.—The psychical Sanskara (भावना) is here omitted.

4. Transmitted force, as in pulling by a string, pushing by a rod, etc.

5. Gravity.

6. Fluidity.

7. Volition.

8. Adrista, comprising various unknown agencies.

In every case of motion produced by contact, Vega is a contributory cause, as the body originating the motion must possess Vega (impressed motion, momentum).

The Concept of Vega (वेगाख्यसंस्कार)

A motion (Karma) being conceived as a change of place in a particle is held to be incapable of producing another motion ; but the pressure, impact, or other force which produces the first motion produces through that motion a Sanskara or persistent tendency to motion (Vega), which is the cause of continued motion in a straight line, i.e. in the direction of the first motion (नियतदिक्क्रिया प्रबन्धहेतुः यद्दिगाभिमुख्येन क्रियाविशेषो जन्यते तद्दिगभिमुक्तेयेव क्रियासन्तानस्य हेतुरिति—श्रीधरः, न्याय—कन्दली, संस्कारनिरूपणम् ।)

The Vaisesikas accept one Sanskara (impressed motion, momentum) lasting till the cessation of the motion. Udyotakara and other writers of the Nyaya

school suppose a series of Sanskaras, each generating the one that succeeds it. (संस्कारेण उत्तरोत्तरकर्मसन्तानो जायते स्वजन्योत्तरसंयोगेन कर्मणि नष्टे संस्कारेण कर्मान्तरजननात् एक एव संस्कारः कर्मसन्तानजनकः न तु कर्मसन्तानवत् संस्कारसन्तानोऽपि अभ्युपगन्तुमुचितः ।).

It will be seen that the Nyaya view is adequate to explain acceleration, which it logically implies. The force of Sanskara (शक्ति) diminishes by doing work (कार्यकारणात्) against a counteracting force, and when the Sanskara is in this way entirely destroyed, the moving body comes to rest (संस्कारो यावत्पतनमनुवर्तते । यथा यथा चास्य कार्यकारणात् शक्तिः क्षीयते तथा तथा कार्यमन्दतरतमादिभेदभिन्नमुपजायते-श्रीधर-न्याय-कन्दली-कर्मग्रन्थ ।).

Vega, it will be seen, corresponds to intertia in some respects, and to momentum (impressed motion) in others. This is the nearest approach to Newton's First Law of Motion.

Vega (impressed motion), or this tendency to move on in a straight line, is counteracted by contact with, tangible objects (स्पर्शवद्द्रव्यसंयोग), e.g. by impact or friction, including friction with the still atmosphere (स्तिमितवायु) as in the case of the arrow.

Vega (momentum) produces work in opposition to the resisting force, and thereby becomes weaker and weaker (मन्दतर, मन्दतम) until it comes to an end (तत्र वेगो मूर्तिमत्सु पञ्चसु द्रव्येषु निमित्तविशेषापेक्षात् कर्मणा जायते, नियतदिक्क्रियाप्रबन्धहेतुः स्पर्शवद्द्रव्यसंयोगविशेषविरोधी । Prasastapada, संस्कारनिरूपणम्-मन्दस्तु वेगः स्पर्शवद्द्रव्यसंयोगमात्रेण विनश्यति यथा अतिदूरगतस्य इषोः स्तिमितवायुप्रतिबद्धधर्म्य-श्रीधर, संस्कारनिरूपणम् ।

Causes of Pressure (नोदन) and of impact (अभिघात)

Pressure is produced by contact acting in conjunction with Vega (impressed motion), elasticity, gravity,

fluidity or volition, eg. the Vega of the wind produces pressure (नोदन) on the grass, that of a current of water on the reed, that of the bow-string on the arrow. Gravity with contact produces pressure, as when the earth sinks under a heavy load.

Impact is produced by contact with a body possessing Vega (impressed motion) where the contact is instantly followed by disjunction (or rebounding). If the contact continues; the result is pressure (नोदन). (तत्र नोदनं गुरुत्व-द्रवत्व-वेग-प्रयत्नान् समस्त-व्यस्तान् अपेक्षमाणः यः संयोगविशेषः नोदनं अविभाग-हेतुः एकस्य कर्मणः कारणं तस्मात् चतुर्षु अपि महाभूतेषु कर्म भवति.....वेगापेक्षो यः संयोगविशेषः विभागहेतुः एकस्य कर्मणः कारणं स चाभिघातः तस्मादपि चतुर्षु महाभूतेषु कर्म भवति— (Prasatapada Bhashya).

It is expressly noted that the four elements, earth, water, air, and fire, are all subject to the forces of pressure and impact. Pressure and impact may be of different degrees (तीव्रमन्दादिभेदः). So also Vega (impressed motion, momentum).

Illustrations of combination of forces

(1) Pressure acting concurrently with impressed motion or Vega, as when the moving hand possessing Vega throws the quoit or a projectile. (पाणिमुक्तेषु गमनविधिः) ततः संस्कारनोदनाभ्यां तावत् कर्माणि भवन्ति यावत् हस्ततोमरविभाग इति— Prasastapada Bhashya.

Similarly, in the case of the bow-string impelling the arrow, or the potter's wheel impelled by the rod, the first motion is due to pressure (नोदन), and results in a Sanskara (persistent tendency to motion, impressed motion or momentum), but the subsequent motions are produced by the pressure acting concurrently with the

Sankara (impressed motion). तस्मात् संस्कारात् नोदनसंयोगात् तावत् कर्माणि भवन्ति यावत् इषुत्व-विनाशः— Prasastapada & Karma Granta. प्रथमं चक्रावयवादि दण्डसंयोगात् कर्म उत्पद्यते उत्तरोत्तराणि कर्माणि अभिघातात् कर्मजात संस्कारात् च भवन्ति दण्डविगम तु चक्रे तदवयवेषु च संस्कारादेव केवलात्। Sridhara-Nyaya Kandali-Karma Granta.

(2) Impact (अभिघात) with impressed motion (संस्कार) as when the mortar thrown by the hand rebounds after striking the pestle (संस्कारापेक्षात् अभिघातात् मुसले उत्पन्नकर्म Prasastapada).

Pressure (नोदन) acting concurrently with impact (अभिघात), as when the mud sinks when we strike against the ground with the feet. Here, if the feet be not in contact with the mud, but only with the surrounding ground, there is transmitted force (संयुक्तसंयोग) पादादिभिर्नुद्यमानाय मभिहन्यमानायां वा पंकाव्यायां पृथिव्यां यत् संयोगोनोदनाभिघातयोरन्यतरापेक्षो उभयापेक्षो वा स संयुक्तसंयोगः। तस्मादपि पृथिव्यादिषु कर्म भवति। (Prastapaada.)

(4) Gravity concurrently with Sanskara or persistent tendency, as in the case of a falling body in the second and following instants. Also the case of a stone thrown against the mud, where gravity (the weight of the stone) combines with the Vega of the stone to produce motion in the mud— (Prasastapada). आद्य कर्म गुरुत्वात् भवति। तेन कर्मणा संस्कारः क्रियते तदनन्तरं उत्तरकर्माणि गुरुत्वसंस्काराभ्यां जायते। द्वयोरपि प्रत्येकं अन्यत्र सामर्थ्याविधारणात्—(Sridhara–Nyaya Kandali, Karma Grantha, Sathprathyaya Karma Nirupanam. This case will be further noted below.

Udyotakara, the commentator on the Nyaya-Bhashya states that a heavier body falls to the ground with

greater Vega (and velocity) than one that is lighter. Udyotakara also holds, and Sridhara agrees with him, that the gravity (गुरुत्व) of a body (अवयवी) as a whole composed of particles (अवयवाः) is not the same as the sum of the gravities of the particles. There is a difference in amount which is, however, so small as to be imperceptible. The concept of mass in the New Mechanics of Lorenz may lend some countenance to this curious metaphysical speculation (Sridhara, Guna Grantha, Guruthwa Nirupana).

(5) Volition acting concurrently with gravity, as in lifting up the hand. This is accompanied by transmission when an object, e.g. the quoit, is lifted by the hand.

Sanskara (impressed motion, momentum), with or without pressure (नोदन) or impact (अभिघात), may be transmitted (दण्डसंयुक्तस्य अवयवस्य उत्तरोत्तरकर्माणि संस्कारात् नोदनाच्च अपरेषां संस्कारात् संयुक्तसंयोगाच्च।—Sridhara).

Composition of Gravity with Vega (Momentum)

When a body is let go and falls to the ground, the force acting on it is gravity (गुरुत्व), which the astronomers ascribe to the attraction of the earth. Motion is produced in the first instance by gravity alone, and this leads to a Sanskara (impressed motion) in the same direction. But the force of gravity continues to operate so that, in the moments following the first, the motion is due to gravity as well as Sanskara. This resultant motion is one, but both the causes must be conceived as contributing to the resultant. The reason for sup-

posing this combined action is that both gravity and Sanskara (impressed motion or momentum) are seen elsewhere to produce motion separately.

In the case of the falling body, therefore, there is the composition of the two, gravity and Vega, acting in the same direction (उभयसमवेशः) from the second instant onwards. It is as if two motions coalesced and resulted in one.

Here a good foundation is laid for the explanation of the accelerated motion of falling bodies, but Galileo's discovery was not anticipated, as Galileo's observations and measurements of motion were wanting. (आद्यं कर्म गुरुत्वात् भवति तेन कर्मणा संस्कारः क्रियते तदनन्तरम् उत्तरकर्माणि गुरुत्व-संस्काराभ्यां जायन्ते द्वयोरपि प्रत्येकं अन्यत्र सामर्थ्यविधारणात्—Sridhara, Karma Grantha—तत् आद्यं गुरुत्वात् द्वितीयादीनि तु गुरुत्वसंस्काराभ्याम्—Prasastapada, Karma Grantha).

But in the case of the flying arrow or other projectile, the impulsive force which produces Vega counteracts the force of gravity; in the end, this Vega is lost through friction with air, and then gravity (गुरुत्व) brings the arrow to the ground. The meaning of this 'counteraction' is not clear. Is it intended that the action of gravity is suspended as long as the Vega continues? We have seen that, in the case of a body let fall, Prasastapada expressly states that gravity (गुरुत्व) and Sanskara (Vega, Momentum) both act in the second and following instants. Prasastapada seems to have thought that some Sanskaras (e.g. the Vega of an arrow or other projectile) suspend the action of gravity. (गुरुत्वं संयोगप्रयत्नसंस्कारौ रोधि, Prsastapada, Guna Granta, वेगेन प्रति-

[illegible] (Prasastapada, Karma Grantha).

Other Sanskaras (e.g. in the case of a falling body) coalesce with gravity to produce a single resultant motion. The later commentators (from Sridhara downwards) certainly interpret the Vaisesika Sutras in this sense.

Motion of a Particle in the Case of a Composition of Forces

Any number of motions or Vegas may be impressed on a particle, but so long as these are in a uniform direction (नियतदिग्विशिष्ट) the resultant motion or Vega is in a straightline, and may be conceived as one ([illegible]-Prasastapada, Karma Grantha). It is only when we come to Gamana (curviliner motion) and its causes that the question of composition assumes a real significance. In all such cases, each separate particle has only one Vega (impressed motion) in a definite direction (नियतदिगभिमुख्य) at any given instant, but the composition of the successive motions and Vegas in the same particle produces the curvilinear motion (गमन) e. g. the rotation of each constituent particle of the potter's wheel. The motion of the body (अवयवी) e.g. the wheel, results from the combined motions of the particles (अवयवाः). If pressure or impact produces motion in an opposite direction to the Vega already impressed on the body, the original direction would be changed, as is seen in the case of rebounding (उत्पतन) after impact (अभिघात). The mortar rebounding after striking the pestle is a typical instance of such change of direction in Vega or motion.

The impressed force, e.g. impact (अभिघात), produces a changed motion in a different direction. One view is that the original Vega (momentum) is destroyed before a new motion and a new Vega are produced by the impact. Others hold that the impact does not destroy the original Vega (momentum), but conjointly with it produces the changed motion and, through such motion, a changed Vega in a new direction. (उदूखलमुसलयोरभिघाताख्यः संयोगो मुसलगतवेगसापेक्षमानः मुसले उत्पतनकर्म करोति यद्यपि प्राक्तनसंस्कारो विनष्टः तथापि मुसलोदूखलयोः संयोगः षट्कर्मोत्पादकः तस्य संस्कारारम्भसाचिव्य-समर्थो भवति अथवा प्राक्तन एव षट्संस्कारः अभिघातात् अविनश्यन् अवस्थित इति। Prastapada—Karma Granta).

Typical cases of Curvilinear Motion (Gamana).

Vortical Motion.—This is due to the contact of two bodies moving in opposite directions with a like or equal Vega, e. g., two currents of air or water meeting from opposite directions. The change of direction is seen in the fact that water which flows downwards, or air which moves obliquely, may receive an upward motion as the result of such collusion. (अथ किमिदं संमूर्च्छनं नाम। समानजवयोः (तुल्यवेगयोः) वाय्वोर्विरुद्ध-दिक्क्रिययोः सन्निपातः। (Prasastapada, Vayu Nirupana).

The scholiast Udayana adds : वाय्वोरिति प्रकृतत्वेन स्पर्शवतोरिति तु विवक्षितम्। अपां यथा द्रव्यान्तरसंमूर्च्छनात् ऊर्ध्वगमनं परस्पराभिहतनदीपवः—Udayana, Dravya Kiranavali. Sridhara notes : तिर्यग्गतिस्वभाव-द्रव्योर्ध्वगतिलाभ परस्पराभिहतजलतरङ्गोर्ध्वगमनवत् असमानवेगयोः संमूर्च्छनं न भवति एकेन अपरस्य विजयात्।

* * * * *

Rotatary Motion (भ्रमण)

Each particle of the rotating body, e.g. the potter's wheel (चक्र), has, at any given instant, a motion in a definite direction. The rotatory motion of the body results from the separate motions of the particles and their persistent tendencies (संस्कारः), joined with the fact of the rigid conjunction of the particles. When the rod strikes one part of the wheel, the motion in the part struck is in the first instant produced by impact (अभिघात); while the other parts move through the transmission of force due to the rigid cohesion of parts. The subsequent motions in the part struck are due to continued pressure (नोदन) and the persistent tendency (संस्कार) set up by the first motion; while the subsequent motions in the other parts are explained by their own persistent tendencies and the transmission due to rigid cohesion. When the rod is disjoined from the wheel the rotatory motion continues, being due merely to the persistent tendencies in the constituent parts and resultant persistent tendency in the whole.

Other varieties of curvilinear motion in bodies are to be similarly explained (i.e. by the composition of Vegas (तथा चक्रादिषु अवयवानां पार्श्वतः प्रतिनियतदिग्देशसंयोगविभागोत्पत्तौ यदवयविनः संस्कारादनियतदिग्देशसंयोगविभागनिमित्तं कर्म तदभ्रमणमिति। एवमादयो गमनविशेषाः। Prasastapada-Karma Grantha).

एवं वेगात् दण्डसंयोगचक्रावयवे आद्यं कर्म दण्डसंयोगात्। अवयवान्तरेषु च संयुक्तसंयोगात् दण्डसंयुक्तस्य अवयवस्य उत्तरोत्तरकर्माणि संस्कारात् नोदनात् च। अवयवे संस्कारात् संयुक्तसंयोगात् च दण्डविगमे तु चक्रे तदवयवेषु च संस्कारादेव केवलात् एवमादयो गमनविशेषाः (Sridhara).

Motion of Fluids

Current motion (स्यन्दन, downward flow in a stream), upward motion (आरोहण, e.g. evaporation, boiling, etc.), and capillary motion (अभिसर्पण, as in plants and porus vessels) are three varieties of fluid motion which require explanation. To this may be added vortical motion (संमूर्च्छन, and स्यन्दन, wave motion).

1. Current Motion (स्यन्दन).

This is conditioned by fluidity in particles, but Sankara Misra notes that in the downward flow of water, gravity in the fluid-particles is the efficient cause (गुरुत्वात् निमित्तकारणात् असमवायिकारणेषु–Sankara Misra, Upaskara). When the water is enclosed on all sides, as in a vessel, the downward flow (स्यन्दन) is counteracted. Here the fluidity does not produce motion, because, in the case of the particles in contact with the enclosing body, there is the resistance (प्रतिबन्ध) of the latter, which is transmitted to the other particles, and this counteracts the fluidity. (श्रोत्रोभूतानामपां स्वाभाविकाभिसर्पणं यत् तत् द्रवत्वात् स्यन्दनं कथं समन्तात् रोधकसंयोगेन अवयविद्रव्यत्वम् प्रतिबद्धं उत्तरोत्तरावयवद्रवत्वानि संयुक्तसंयोगैः प्रतिबद्धानि।—Prasastapada, Karma Grantha).

2. Upward Motion (आरोहण e g. evaporation).

In evaporation the fluid-particles are rarefied, and remain in a fine state of suspension; the rarefaction is due to the impulse (नोदन) or impact (अभिघात) of the heat-particles in the sun's rays, and the upward movement is due to their contact with the air under this impulse or impact. Sankara Misra notes that in boiling there is a similar upward movement of water-particles under the impact of heat-rays. (नाड्यो वायुसंयोगात् आरोहणं

नोदनापीडनात संयुक्तसंयोगात च—Sutras 5 and 6, Ahnika 2, Chap. 5, Vaisesika Aphorism. यथा स्थालीस्था आपः क्वथ्यमानाः वायुनुन्नादिरसन ऊर्ध्वं नयन्ति ।— SankaraMisra).

N. B.—These two sutras of Kanada have been interpreted by the late Gangadhara Kaviratna in his commentary to refer to the upward conduction of water in pipes by the pressure of air.

The mention of the transmitted pressure (संयुक्तसंयोग) of the air seems to lend some countenance to Gangadhara's view, and the word Nadi (नाड्यः) offers no difficulty, being taken in its usual sense, "pipe" (नालिका Nalika), while the current interpretation does violence to the common acceptation of the word.

3. Capillary Motion (अभिसर्पण).

Two instances are given—the ascent of the sap in plants from the root to the stem (अभितः सर्पणं मूले निषिक्तानामपां वृक्षे ।—Sankara Misra), and the penetrative diffusion of liquids in porous vessels, e.g. of the oil or ghee in an earthen jar (कुम्भादौ अन्तर्निहितानां तैलघृतादीनां स्यन्दनं श्रपनञ्च). Heat-particles have a like pentrative power (दृष्टश्चानिरोधो भर्जनकपालादौ तेजसः पच्यमानद्रव्यपाकसिद्धेः कलशे च निषिक्तानां अपां शीतस्पर्शोपलम्भादनिरोधः । Jaynta, Nyaya Manjari, Ahnika 8, इन्द्रियाणां प्राप्यकारित्वम्).

This is ascribed to Adrista, as the cause cannot be ascertained by either perception or inference (including hypothesis) (प्रत्यक्षानुमानाभ्यां अनुपलभ्यमानकारणम । Sridhara).

INTERESTING EXAMPLES OF MOTION ASCRIBED TO ADRISTA (UNKNOWN CAUSE, UNEXPLAINED NATURE, FINAL CAUSE).

The first motions in primordial atoms at the beginning of Creation are attributed to Adrista. Among

movements in masses of matter so caused are noted the motion of the globe of the earth and similar other bodies (महाभूतानां भूगोलकादीनां प्रक्षोभने चलनम्-Prasastapada with Sridhara's commentary, Karma Grantha). Most probably this means earth-quakes, tides, etc. Aryabhatta and his school would no doubt bring under this head the diurnal motion of the earth. It is interesting to note in this connection that Bhaskara refutes the Buddhist hypothesis of the earth falling perpetually *in vacuo* by arguing that the earth must remain balanced in space, as there is nothing outside to attract it.

The movement of the needle (iron in general, as Sankara Misra notes) towards the magnet is another example of unexplained motion in matter. Cleaning and right-placing of the magnet (संमार्जनम् ऋजुस्थापनम्) are necssary (सूचीनां लौहशलाकानां, अयस्कान्ताभिमुखगमनम् सूचीत्युपलक्षणम् अयस्कान्ताकृष्टलोहमात्रमभिप्रेतम्। Sankara Misra).

Similarly, amber attracts grass, straw, etc. (तृणकान्तमण्याकृष्टानां तृणानां गमने–Sankara Misra, on Sutra 15, Ahnika 1, Chap. V.)

Involuntary movements of the hand under the influence of the hypnotist's *Mantras* (incantations) are also attributed to *adrista*.

Measurement of motion—Units of space and time

The solar day was taken as a natural measure or division of time. In the Nyaya-Vaisesika school the day of twenty-four hours (solar) is stated to contain 30x30x30x18x2x2 units of time (Ksanas). The Nyaya

unit of time, therefore, measures 2/45 of a second. The smallest measure of time mentioned by the astronomers is the Truti, which is 1/33757 of a second.

The natural measure of length was the cubit (Hasta), of which there were two fixed standards, the greater and the lesser cubit. The smallest measure of length mentioned in the Silpa Sastra (Technology) is the Paramanu, which is about 1/349525 of an inch. This is the same as the Trasarenu of the Nyaya-Vaisesika school, which stands for the thickness of the minimum visible (the finest mote perceptible in the sunbeam as it comes slanting into a dark room through a chink).

Average velocity (स्थूलगति—Bhaskara) was measured in accordance with the formula $v=\frac{s}{t}$, but no unit of velocity appears to have been fixed upon. There was no idea of acceleration, and of course no measurement of force. Mahaviracharya gives formulae for computing the space travelled over in cases of Sankalitagati (velocity with regular increment at stated intervals), but this does not amount to acceleration, as the intervals are not indefinitely small. Where the, velocity is uniform, the interval of time may be of any amount (स्थूलकाल), but where the velocity is variable (प्रतिक्षणं न समा गतिः—Bhaskara), an indefinitely small quantity of time (सूक्ष्मकाल) must be taken; in other words, the positions of the particle in two successive instants must be considered, and the velocity must be supposed to be uniform during this interval (conceived as indefinitely small, -सूक्ष्म). It was in this way that Bhaskara determined the instantaneous motion of a planet (तात्कालिकी गतिः).

Component of Velocity

The astronomers measured the motion of a heavenly body in different directions (longitude, right ascension, etc.), and calculated separately the components of motion (गतिकला:) in these directions, and they adopted the device of transferring such component velocities from one body to another in the computation of relative motion (e.g. एवं सति आचार्येण लाघवार्थं इष्टघटीसम्बन्धिन्यो गतिकला अर्के प्रक्षिप्ता:। Bhaskara, Siddhanta-Siromani, Ganitadhyaya, Ghatisphuti-prakarana).

Notion of three axes

Motion, we have seen, was defined as the change of position of a particle in space, To conceive position in space, Vachaspati takes three axes, and the position in space of one particle relatively to another may be indicated by distances measured along these three axes. This remarkable analysis (circa 842 A. D.: वस्वङ्कवसुवत्सरे Vachaspaspati. Nyayasuchinibandha) anticipates in a rudimentary manner the foundations of solid (co-ordinate) geometry, eight centuries before Descartes.

The Principle of the Differential Calculus applied to the Computation of Motion (Variable Motion).

Bhaskara (1150 A. D) in computing what he calls the "instantaneous" motion (तात्कालिकी गति) of a planet compares its successive positions in two successive instants, and regards the motion as constant during the interval, which he conceives to be indefinitely small (सूक्ष्मकाल). This is equivalent to the determination of the differential of the planet's longitude, and the process bear's a strong analogy (to quote the words of

Mr. Spottiswoode, the Astronomer Royal)" to the corresponding process in modern mathematical astronomy." I have elsewhere shown that Bhaskara's process was not merely analogous to, but virtualiy identical with, that of the Differential Calculus, Mr. Spottiswoode's cautious reservation having been due to his want of acquaintance with the original and the insufficiency of the materials placed before him.

Relative Motion

The phenomenon is noticed among the hallucinations of sense (नाव्यारूढाश्च गच्छन्तः पर्वतादीनि विजानन्ति भ्रमे भ्रमतश्च तान् । —Kumarila, Sloka-Vartika, p. 520). Astronomers like Aryabhata and Lalla, who believed in the diurnal revolution of the earth from the west to the east, explained the apparent revolution of the starry heavens in the opposite direction by the principle of relative motion.

Serial motion

Several Santanas (series) of motions are incidentally noticed, e.g. vibration (स्पन्दन, कम्पसन्तान), wave motion (वीचीतरङ्ग), current motion (स्यन्दन).

In an interesting passage, Charaka notes three instances of serial motion, viz. those of water, sound and light (जलसन्तान शब्दसन्तान and अर्चिःसन्तान) to which he compares the course (सन्तान) of chyle (or chyle–blood) in the Dhamanis (veins) and other ducts of the body.

Dalvana thinks that downward, oblique, and upward currents of chyle are respectively intended by the three illustrations; but Chakrapani points out that the Santana (wave) of sound travels in all directions

(the same is of course true also of light), and that differences in speed (and not in direction) are here meant. In other words, a Santana of sound travels more rapidly than that of water, and less rapidly than one of light (अर्चिःसन्तान), and Charaka's meaning is that the metabolic course may complete its circuit with greater or less speed. Whether, in this passage, the three Santanas are viewed as waves or currents, is not specified; but the difference between a wave (वीचि), and a current (स्यन्दन) was well known.

A current of water (स्यन्दन, downward flow) consists of particles moving in an uninterrupted series under the action of gravity and fluidity (गुरुत्व and द्रवत्व Sankara Misra). A wave (वीचीतरङ्ग), on the other hand is constituted by the transmission of vibratory motion (स्पन्दन) in the water particles (e.g. Jayanta, पतदुनपयो-बिन्दुसन्दोहस्यन्दनक्रमात् ।—Nyaya-Manjari, Ahnika 2).

A ray of light, on the other hand, was supposed to imply the rectilinear propagation of indefinitely minute corpuscles in all directions, with inconceivable velocity, and a sort of conical dispersion (अचिन्त्यो हि वेगातिशयः तेजः प्रसर्पति पृथग्व्रत्वात् —Udyotakara, Vachaspati).